



The Research Strategy for the Building and Construction Industry



Under Pohutukawa, by Herbst Architects. Winner of a 2012 New Zealand Architecture Award. Photo: Patrick Reynolds.

Cover images:

House on Otago Harbour, Architectural Ecology Ltd;

Te Wharewaka, by architecture+, winner of a 2013 New Zealand Architecture Award. Photo: Paul McCredie

Foreword

In 2009, government and industry worked together to develop *Building the Future* – a document that looked at the challenges and opportunities facing New Zealand's building and construction industry in coming decades.

A key idea that emerged from this work was the concept of having an overarching building and construction research strategy. Given the amount of money and effort that goes into building and construction-related research every year, it is important to industry and government that funding is spent in a co-ordinated manner and that it results in better-quality innovation, knowledge and buildings that meet the needs of New Zealanders. This strategy is the result of close collaboration and co-operation between industry and government. It seeks to guide those who fund and engage in building and construction research in New Zealand.

A successful and innovative building and construction industry is critical to New Zealand as we look to provide the homes, workplaces and communities that will secure firm foundations for current and future generations. Research is essential to help us find new and better ways of achieving our goals.

We also face the distinct challenge and opportunity of rebuilding one of New Zealand's largest cities, Christchurch. New ideas and solutions will be needed as a generation of work reshapes much of the city's buildings and infrastructure. Similarly, Auckland will undergo significant change over the next few decades as its population grows by 40% from its current 1.34 million to 2.5 million by 2040. We are also expecting to see further concentration of employment and high-value production activities in the

Auckland region. If we are to meet these twin challenges and influence and improve building and construction across the whole of New Zealand then changes in what and how we build will be required.

The building and construction industry is increasingly complex, and we need to understand the impacts that decisions in one area have on the rest of the system and New Zealand as a whole. This strategy sets out the building and construction industry's research needs as identified by both research users and researchers, and also aims to improve the value for money from investment in research. The strategy and research work programme that flows from it will be regularly reviewed and updated.

Industry, MBIE and BRANZ represented through the Construction Industry Council and Construction Strategy Group, have worked in partnership to develop this strategy. Together, we will work to ensure its implementation. Our aim is great research and research capability that is able to meet New Zealanders' needs now and into the future.

We'd like to thank all of those individuals and organisations who have contributed to this strategy and who will help realise its ambitions.

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Supporting organisations

The building and construction industry is large and diverse, with over 100 professional bodies and thousands of small companies. This makes it challenging to develop a shared vision and priorities. To help focus efforts around research and innovation, this strategy has emerged from a process of industry-wide consultation and is supported by key industry leadership and co-ordinating bodies.

Construction Strategy Group www.constructionstrategygroup.org.nz

The Construction Strategy Group (CSG) is a high-level strategy group that brings together leaders in the construction industry in New Zealand to provide leadership and strategic direction to grow a productive value-driven professional construction industry.

The CSG has a range of functions including engaging with Ministers, officials and key players in the construction industry; determining strategic goals and priorities of the industry; and overseeing and facilitating construction industry input into key processes that affect the industry such as the Building Act review.

The CSG commissioned the PricewaterhouseCoopers (PWC) report *Valuing the role of construction in the New Zealand economy*¹ which highlights the industry's importance to the New Zealand economy and the potential for the industry to grow.

Construction Industry Council www.nzcic.co.nz

The Construction Industry Council (CIC) brings together peak bodies and agencies with connections to the construction industry to promote the interests of the broader construction industry to central government, and create conditions in which the industry can prosper and work together for the general good of the construction industry.

The CIC counts as its members all relevant peak industry bodies across the full industry value chain.

Ministry of Business, Innovation and Employment www.mbie.govt.nz

The Ministry of Business, Innovation and Employment (MBIE) was formed in mid-2012 to be the catalyst for a high-performing economy to ensure New Zealand's lasting prosperity and wellbeing. MBIE incorporates the functions of the former Department of Building and Housing, Department of Labour, Ministry of Economic Development and Ministry of Science and Innovation.

BRANZ www.branz.co.nz

BRANZ is New Zealand's independent building and construction organisation focusing on science and engineering research and information. Its activities are funded through an even mix of Building Research Levy and commercial income. BRANZ delivers research and knowledge dissemination with and for industry and regularly connects with over 100,000 members of the building and construction industry turning world-class science, research and innovation into practical benefits for New Zealanders.

¹ PricewaterhouseCoopers. October, 2011. *Valuing the role of construction in the New Zealand economy: A report to the Construction Strategy Group.*



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Introduction

We are very pleased to bring you this research strategy for the building and construction industry. The purpose of the strategy is to bring together into one document all the significant issues facing the building and construction industry in order to provide a research programme and research direction to researchers and funders.

The strategy was developed collaboratively by the Construction Industry Council (CIC), Construction Strategy Group (CSG), Ministry of Business, Innovation and Employment (MBIE) and Building Research Association of New Zealand (BRANZ). It was informed by interviews and discussions with organisations and individuals from across the building and construction industry, and by an extensive industry needs survey. The survey results can be found at www.buildingabetternewzealand.co.nz.

The strategy addresses the key challenges facing the industry and identifies research priorities. While the nature of our industry suggests that the themes set out in this strategy are likely to be consistent over time, the emphasis on themes and subjects within themes will change over time. Priorities will be revisited regularly to ensure that the strategy takes into account developments in policy, practice, technology and knowledge.

The building and construction industry is New Zealand's fifth largest sector. It contributes about 4.3% to GDP and employs one in every 12 New Zealanders in the workforce, or roughly 178,000 people².

Output from the sector dominates New Zealand's investment, contributing some 45% of all gross fixed capital formation. The industry is significant to our economy and the social fabric of New Zealand as well as supporting many of our export industries. However, in recent years, it has become characterised by significantly reduced work volumes, declining productivity, declining skill levels, mixed quality craftsmanship and management, poor accountability and the need to streamline the regulatory framework and make it more effective.

Although there is currently no agreed industry-wide vision for the New Zealand building and construction industry, a number of organisations and programmes have developed visions for their part of the sector. In analysing these, it is clear that they have many common elements. The following vision has been developed for this strategy, and it draws together the key elements and aspirations of these.

A building and construction industry that delivers:

- well designed, built and performing homes and buildings that meet the needs of all New Zealanders and their communities now and into the future

- a built environment that is affordable today but that will stand the test of time
- the modernisation of our existing homes and buildings so that they meet our changing needs and aspirations
- a vibrant, sustainable and productive building and construction industry that is capable of delivering on these aspirations and plays its part in supporting New Zealand's economic wellbeing
- a highly skilled and competent professional workforce that is passionate about and committed to a building and construction industry that delivers attractive and achievable career opportunities.

The Building Act 2004 is the primary legislation controlling building and building work in New Zealand, providing the regulation of building work, the establishment of a licensing regime for building practitioners and the setting of performance standards for buildings to ensure that:

- people can use buildings safely and without endangering their health
- buildings have attributes that contribute appropriately to the health, physical independence and wellbeing of the people who use them
- people who use a building can escape from the building if it is on fire
- buildings are designed, constructed and able to be used in ways that promote sustainable development.

The Canterbury earthquakes have also reinforced the critical importance of the design and construction of buildings that are resilient to the particular challenges of New Zealand's natural environment.

This strategy contributes to the achievement of this vision for the building and construction industry and the purpose of the Building Act 2004 by building knowledge through world-class research and knowledge transfer.

Building and construction research

The development and implementation of policy and practice in any industry works best when it is anchored in an evidence-based approach. This is especially important in building and construction where the consequences of policy and practice are in place for a long time (buildings have long lives and are very visible) and mistakes can be difficult and costly to fix.

² PricewaterhouseCoopers. October, 2011. *Valuing the role of Construction in the New Zealand economy: A report to the Construction Strategy Group.*

Like many other countries, the New Zealand building and construction industry has long recognised the importance of research and information. That's why, in 1969, BRANZ was established as a specialist research organisation, and why the Building Research Levy was put in place as a source of research funding to deliver industry investment alongside government funding. More recently, BRANZ has produced a research and information agenda to guide investment of the Levy into research and shape the delivery of the outcomes of that research to industry.

In addition to BRANZ, which has a specific focus on building research, there are a wide range of other research providers servicing government and industry in New Zealand, a number of whom deliver research to the building and construction industry.

Although the Building Research Levy is a significant part of the funding equation, there are other funding mechanisms accessed by industry, most notably, statutory funding from government and its agencies. In order to realise maximum benefit for the building and construction industry and New Zealand, it is vital that funding agencies have a common understanding of industry needs and priorities for research and that research funding forms a coherent package that will assist the building and construction industry and New Zealand to grow and prosper.

Throughout the development of this strategy, industry, government, policy-makers, businesses and regulators have worked together to develop a shared strategic view of the information required to meet the needs of the building and construction industry. An industry-wide strategy will help ensure that this wealth of experience and expertise addresses the key research needs of the building and construction industry, now and into the future.

As the name of the strategy implies, the ambition is a simple but important one – Building a Better New Zealand.

Beyond the research

Research is only one of a number of things that needs to happen if a sector is to improve its performance and transform itself towards a desired future state.

Other supporting initiatives usually required include:

- information campaigns
- education and training
- changes to industry structures and behaviour
- benchmarking and best practice
- supportive regulation
- professional and ethical behaviour
- informed clients.

This strategy intentionally focuses on research and does not address these other initiatives. This does not mean they are not important or that industry and government are not actively working in these areas. The following section lists a range of strategies that encompass actions wider than research.

Links to other strategies

It is important to note that this strategy does not seek to replace existing strategies from within the building and construction industry. Rather, its purpose is to bring together the building and construction-related research

elements of these strategies. Doing this is particularly important if research investment in the building and construction sector is to be optimised.

The strategy has a primary goal of supporting research funders to better target the agreed research needs and priorities of the industry.

During the development of this document we have identified a number of strategies that are relevant to building and construction research including:

- BRANZ Research and Innovation Agenda 2012
- Building the Future – Four Visions of the New Zealand Built Environment in 2025
- Canterbury Earthquake Strategy (supplement to the Research Strategy of the Natural Hazards Research Platform)
- Canterbury Earthquakes Royal Commission Final Report – Part One
- CIC Health & Safety Strategy: Construction Industry in New Zealand 2005–2010
- CIC Principles of Best Practice: Construction Procurement in New Zealand January 2006
- CRC Construction Innovation: Construction 2020
- Department of Building and Housing Expert Panel Report Structural Performance of Christchurch CBD Buildings in the February 2011 Aftershock
- EQC Research Strategy
- Heavy Engineering Research Association – Annual Report 2011
- Heavy Engineering Research Association – New Zealand Metals Engineering Industry Position on Public Policy Issues 2012
- IPENZ Catalysing Economic Growth – Boosting Innovation Expertise in the Private Sector
- Local Government Work Programme 2011/12
- National Infrastructure Plan – Resilience
- Natural Hazards Platform: Interim Research Strategy
- New Zealand Forest and Wood Products Industry Strategic Action Plan
- New Zealand Productivity Commission – Housing Affordability Inquiry
- Productivity Partnership Research Action Plan
- Submissions to the Royal Commission of Inquiry into Building Failure Caused by Canterbury Earthquakes
- The Auckland Plan
- The Business Growth Agenda
- Wood Processing and Manufacturing Science and Innovation Plan.

A full list of strategies and documents identified in the strategy can be found in Appendix C on page 31.

What is the built environment?

The built environment encompasses both vertical and horizontal infrastructure. For the purposes of this strategy, it encompasses the places where people live, work and play, particularly in the urban environment. It includes homes, businesses, public buildings, transport, infrastructure and urban spaces³.

The scope of this strategy includes the vertical infrastructure elements of the built environment. Horizontal infrastructure elements such as roading, pipeline and cable networks are outside the scope of this strategy.

³ Bates, Bayne, & Killerby. 2001. Room for a view: Three visions of the future built environment in Australasia. *Forest Research Bulletin*, 224.

Strategic research needs

Building a Better New Zealand and the work programmes that underpin it focus on providing information and analysis to better understand the issues facing the building and construction industry.

The research needs were identified through consultation within the industry and with external stakeholders. For some areas, such as productivity, significant amounts of work to identify research needs and priorities have recently been undertaken. Where this is the case, the research needs and priorities identified have been adopted as needs and priorities in this strategy.

The strategy identifies priorities but is neutral in regard to the best mechanisms for addressing each challenge. The optimal solution will vary depending on the set of circumstances and the characteristics of the affected sector and it is likely that, for many issues, there will be multiple solutions.

Although nine themes have been identified, their boundaries overlap.

Therefore, learnings from one theme will frequently inform issues in other themes. Similarly, solutions for one part of the industry may be applicable to other industry groups.

As noted, the intention is to co-ordinate research needs and ambitions and not to duplicate work that has already been undertaken. Details of the initial consultation that took place and the individuals and organisations who participated in this process are contained in Appendix B.

LOD300 (Level of Development) BIM Model of Building 302 – University of Auckland
Image credit: Architectus and BECA



The research needs and priorities have been grouped into nine themes:

- Better buildings
- Materials performance
- Maintaining and improving the performance of existing buildings
- Sustainability
- Automation, industrialisation and new technologies
- Operating environment
- Productivity
- Meeting the housing needs of all New Zealanders
- Building better cities and communities.

The following sections of the strategy expand on each of these themes.

A shifting sector

- Lessons from Canterbury are highlighting areas of research concerning the resilience of buildings and infrastructure under seismic hazards. A Royal Commission of Inquiry and a number of reviews relating to building performance and standards have been undertaken since the Canterbury earthquakes. As findings from these inquiries and reviews have been released they have been incorporated into the strategy.
- Over the foreseeable future, more research needs will emerge, and these will be added to the research needs and priorities as appropriate. A process, such as a roadmap, for prioritising these research needs and developing a plan to address them within available resources will need to be put in place.
- The Ministry of Business, Innovation and Employment (MBIE) is currently undertaking a review of New Zealand's standards and conformance infrastructure, with a specific focus on the standards system. The outcome of the review will be proposals for a viable and well functioning standards system that meets the needs of businesses, regulators and consumers in the foreseeable future. Specific research needs and priorities identified as a result of this process will be reviewed and added to this strategy where relevant.



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Better buildings

Buildings are fundamental to our way of life. Not only are they where we live, work and play, they are the foundations of our economy and represent the majority of fixed assets in New Zealand. Improving the quality, function and performance of our buildings is a vital foundation for supporting New Zealand's economic growth.





Knoll Ridge Café, by Harris Butt Architecture. Winner of a 2012 New Zealand Architecture Award. Photo: Simon Devitt.

Providing good-quality buildings, including housing, schools, workplaces and so on in the future is important for all New Zealanders.

Building envelope

The building envelope is the materials and systems that come between the interior and the exterior environments of a building.

The functions of the building envelope can broadly be separated into three main categories⁴:

- Support (to resist and transfer mechanical loads).
- Control (the flow of matter and energy of all types, for example, rain, heat, air and vapour).
- Finish (comfortable and serviceable finishes to support human activities on the inside and outside).

A typical building envelope will include familiar component parts such as foundations, a roof, walls, doors and windows. The behaviour and performance of each component part may be well understood; however, it is the inter-relationship between different parts of the building envelope that are primary factors in the effectiveness and durability of the system as a whole. A component may be specified, designed or constructed to a high standard in its own right, but if it isn't part of an

effective system, it may fall short in performance.

As a result of historical leaky buildings issues, New Zealand is well aware of the importance of getting our building envelope right. Weathertightness continues to be a high priority information need for industry. Interest continues to broaden beyond simply how to keep water out of buildings, into holistic consideration of the building (including the envelope) as a system in its own right, including heating and ventilation as means of managing the building's moisture.

An independent report commissioned by the then Department of Building and Housing (DBH) and produced by PricewaterhouseCoopers (PWC) estimated that approximately 42,000 houses built between 1995 and 2005 have weathertightness issues and require repair. The economic cost (including repair and transaction costs) of fixing these is estimated at between \$6 billion and \$23 billion (in 2008 dollars). The industry has developed effective methods to remediate weathertightness-related damage. However, it is important that we use this experience to make positive improvements in monitoring and maintaining building performance.

Since the Canterbury earthquake sequence began in September 2010, the structural elements of the building envelope have also come sharply into focus. While the Building Code requirements prevented loss of life in modern Code-compliant buildings, building damage and the consequent disruption to people's lives and the Christchurch economy have questioned both the extent and range of services we require from buildings and what happens when those services are not provided. There are already signs that the impacts of the Canterbury earthquake will be felt in other parts of New Zealand, with buildings being closed because they are considered to be below the level of acceptable risk for occupation. However, many buildings performed well during the earthquakes, which also offers valuable insights for future building system performance. The cost of the Canterbury rebuild has been estimated at up to \$40 billion, not taking into account the cost of any betterment. The full scale of the challenge facing New Zealand is still to be quantified.

Earthquakes are not the only natural hazards that cause costly damage to buildings and infrastructure. In 2011, excluding the Canterbury earthquake events, the insurance industry paid out approximately \$58 million, and in 2010,

⁴ Straube & Burnett. 2005. *Building science for building enclosures*.



almost \$72 million in claims arising from hazard events including storms, flooding and tornados. Over the last 5 years, excluding claims arising from the Canterbury earthquake events, the insurance industry has paid out more than \$360 million⁵ in claims relating to damage caused by natural hazards. Not included in the definition of natural hazards, but significant in the damage it causes, is fire. In 2005, BERL⁶ estimated that the cost of insurance claims for fire-related damage was in the order of \$164 million per annum (in 2005 dollars).

As hazards continue to pose challenges to New Zealand's building stock, understanding the balance between risk and probability will be crucial. Research to make our buildings more resilient to the effects of hazards will need to adopt a 'value at risk' lens to avoid over-engineering and ensure the effective use of our preventative skills. This will require

careful examination of the complex relationship between risk, risk profiles and the built environment against the backdrop of a rapidly changing insurance market.

Further research to make our buildings more resilient to the effects of hazards, while avoiding over-engineering, is required.

Taken together, damage caused by natural hazards, the Canterbury earthquakes and leaky buildings highlights the human and economic importance of better understanding our building envelope. Investment in research in this key area is one of the core foundations of our built environment.

Internal environment

While information about our housing stock has improved, there remains very little published information available on the condition of non-residential

buildings and the impacts that their interior conditions and deferred maintenance can have on occupant health, productivity and wellbeing. A BRANZ pilot study on the condition of small commercial buildings suggested that there are potentially a significant number of commercial buildings in poor or worse condition. Work is also under way to gather important information on energy and water use in non-residential buildings.

The 2010 House Condition Survey, jointly funded by BRANZ and the then Department of Building and Housing, showed that a considerable proportion of residential properties are in below-average condition. Issues such as dampness and cold surfaces can lead to the growth of mould inside houses, which can be dangerous to the health of occupants. Exposure to mould spores can lead to and trigger a variety of health issues in humans such as asthma and allergies. Despite research

⁵ MBIE. Feb, 2013. *National science challenges: Potential challenges for consideration by peak panel – Inclusive, innovative and secure society.*

⁶ BERL 2005. *The cost of managing the risk of fire in New Zealand.*



House on Otago Harbour Architectural Ecology Limited.

and marketing campaigns, and the use of subsidies, many houses remain inadequately insulated. As building envelopes become more airtight, indoor moisture and air-quality issues will increase unless new and retrofit interior systems are developed to work with rather than against more airtight building envelopes.

The quality of existing buildings in New Zealand is likely to remain a national problem for the foreseeable future and requires further research into areas including understanding the condition of buildings, materials performance and durability, maintenance and upgrade, understanding consumer behaviour, costs and benefits of better buildings and so on.

Research topics

Resilient buildings

- The performance of building systems has come into sharp focus since the

Canterbury earthquakes and recent storm and flood events. Further research is required to develop methods for evaluating and rating the resilience of building systems.

- Development of new building systems that are resilient to all natural hazards while being cost-effective and sustainable.
- Understanding the role of technology in monitoring building movement and structural integrity.
- New Zealand's existing building stock will continue to form the bulk of our building stock. Research is required to understand the cost-benefit of improving buildings' performance.
- Improved understanding of building and materials behaviour in order to improve resilience and performance.
- Research into providing resilience of interior linings and exterior claddings under seismic loading would achieve significant reductions in earthquake damage. The development of solutions in this area could result

in housing stock being much more resilient to the natural hazards present in New Zealand.

- Improved resilient design of buildings that include, for example, better consideration of the post-elastic performance of buildings.

Moisture in buildings

- Managing moisture in buildings remains a key priority for the industry, and a robust calculation basis for moisture design would support improvements in this area. The benefits and requirements of such a model should be explored and, if beneficial, taken forward.
- Moisture-tolerant walls, roofs and floors that still meet health, warmth, comfort and durability goals would deliver improvements in building envelope performance for New Zealand homes and business. Work should be carried out to identify relevant material characteristics which would provide such qualities.



- In order to improve our understanding of building envelope systems and the impact of changes in one area on the system as a whole, work should be undertaken to develop methods to avoid future moisture-related issues resulting from changes to materials, designs and construction methods. An important component of this is understanding the relationship between indoor and outdoor air quality and moisture, in particular the need to consider airtight buildings and mechanical ventilation as parts of the same building system rather than discrete components.

Indoor air quality and moisture control

- Technologies, products and methods to improve indoor air quality.
- Technologies and methods to optimise the performance of indoor space-conditioning systems.
- Solutions to improve indoor environments to address moisture issues.
- Understanding the condition of interior systems in non-residential buildings.
- Understanding the drivers of building owner behaviour in order to develop appropriate methods to incentivise

the upgrade of interior systems components that negatively impact on the health and wellbeing of occupants.

- Methods to understand and measure relevant levels of performance in order to compare different interior systems.

Ventilation

- As both new and existing homes and buildings become better insulated and more airtight, the importance of understanding the role of ventilation is increasing. How can New Zealand develop better ways to ventilate homes that are more energy efficient and target moisture more directly?

Acoustic performance

- Understanding methods for improving acoustic performance without compromising other elements of the building system.
- Methods to deliver high-quality acoustic performance in higher-density housing, without compromising useable space.
- Understanding the drivers of building owner behaviour in order to develop appropriate methods to incentivise the upgrade of acoustic systems in existing buildings.

Fire

- Tools and techniques to ensure that new and existing buildings and structures perform more dependably in fire situations, including post-earthquake fires, at a whole-of-structure level as well as an elemental scale.
- Tools and techniques to improve levels of risk and uncertainty in fire safety engineering and better providing a sound technical basis for the performance-based regulatory framework in New Zealand.
- Understanding the implications of sustainability for fire safety and protection.
- Assessing the impact that new technologies could have in improving the cost and effectiveness of fire safety systems.
- Improving our understanding of the effectiveness of installations of fire safety provisions in the New Zealand market and how well services are matching specifications.

Links to other strategies and key documents

- Building Energy End-use Study (BEES)
- Household Energy End-use Project (HEEP)
- Weathertightness, Air Quality, and Ventilation Engineering programme (WAVE)
- Productivity Partnership Research Action Plan
- House Condition Survey
- Canterbury Earthquake Research Strategy (supplement to the Research Strategy of the Natural Hazards Research Platform)
- Research Strategy of the Natural Hazards Research Platform
- Structural Performance of Christchurch CBD Buildings in the 22 February 2011 Aftershock; Report of an Expert Panel appointed by the New Zealand Department of Building and Housing
- Canterbury Earthquakes Royal Commission Reports
- EQC Research Strategy
- Fire Research Roadmap

Materials performance

Research into materials and their performance is an area that is consistently rated highly by industry. We need to clearly understand how the materials used in our built environment perform, both as distinct products and as part of increasingly complex systems.



Auckland Art Gallery by FJMT + Archimedia in association, winner of the 2013 New Zealand Architecture Medal. Photo: Patrick Reynolds.

As the range of materials used in the built environment continues to change, the opportunities presented by investing in materials performance are significant – both within New Zealand and for businesses looking at the export potential of their ideas. For example, research on materials performance has contributed to the replacement of preservatives in timber that are harmful to humans and the environment.

Indeed, it is more than possible that the next breakthrough in

transforming our built environment will come from a scientist, architect or engineer. Why? Because our future buildings will be shaped as much by the materials used in their construction as by the designers and builders who create them.

Today, technical experts are not only working on new products and systems that aim to be stronger, more economical and more sustainable than their predecessors, but they are also looking at new generations

of smart materials. Smart materials interact with the environment around them and are able to respond and adapt to it. For example, they can react to heat or light, stress or moisture – even to pollution.

While new technologies are emerging that have the potential to transform the spaces in which we live and work, there is also a need to ensure that the materials we use and work with today are meeting our existing needs.

Building materials research is broad

- **Traditional materials** – the majority of building and construction uses familiar, traditional materials. Research can help us make improvements in the performance of these day-to-day materials – whether metal, timber, glass or concrete – particularly in the transformation from one material to another across component boundaries.
- **New materials** – research can help us understand the viability and applicability of new and innovative building materials, such as composites, new aggregates or products utilising nanotechnology.
- **Best use of existing materials** – for example, through using modular design.
- **The reuse of existing materials** – making the best use of existing materials is increasingly important. Research can help us look at different or new uses for byproducts from manufacturing processes that might otherwise be considered waste and go to landfill. It can also improve our understanding of how to best recycle materials and how they will perform, as well as the economic and sustainability cases; for example, sorting timber waste from Christchurch to minimise landfill use, generate energy and reuse elsewhere in the rebuild.
- **Indigenous materials** – a range of indigenous materials are used in building and construction. In New Zealand, there may be scope to explore the role that mātauranga (traditional Māori knowledge) can play in this area – exploring indigenous knowledge and science and innovation around materials.

- **Low environmental impact materials** – new materials can make an important difference to sustainability. Research into low-impact materials can help us reduce waste and secure environmental gains during manufacturing, construction, demolition and reuse.
- **Performance assurance** – there can be an uneasy tension between materials that usually have well defined characteristics and products that are made from combinations of materials. Materials and products can combine in ways that confound the expected characteristics of a single material or product, especially durability performance. Practitioners have long been aware of this and often show strong suspicion of ‘new’ products until a performance history is established. Materials research can help provide assurance about the performance of materials and the products and systems in which they are used.

Research topics

Performance of systems/ effects of new materials on existing materials

- What are optimal building systems for different environments?
- How does the performance of different products change when integrated into building systems?
- What are the barriers to improving materials performance?
- What are the weak links in building systems – where are the opportunities to most improve materials performance?

Performance of new materials in existing systems

- What new materials can be developed to improve building performance by enhancing or replacing existing materials?
- How do new materials integrate into existing systems?

Performance of existing materials in new applications

- How can existing materials be applied in new applications that improve the performance of both the materials and buildings they are used in?
- What are robust methods for establishing a performance history?

Improving the performance of materials

- What new building solutions will increase building performance while at the same time improve the performance of sectors within the building and construction industry?
- To what extent is material quality understood and monitored within New Zealand? Can improved quality assurance systems in the testing and confirmation of material properties be put in place?

Product assurance

- Are the pathways and processes for assessing and approving new materials and products for use in construction working?
- What improvements are possible or needed?
- What is the appropriate approach to product and material traceability that should be employed in New Zealand?

Links to other strategies and key documents

- Cement and Concrete Association Research Strategy (under development)
- New Zealand Metals Engineering Industry Position on Public Policy Issues 2012
- HERA Annual Report 2012
- New Zealand Forest and Wood Products Industry Strategic Plan
- Department of Building and Housing Using the Product Assurance Framework 2010

Maintaining and improving the performance of existing buildings

85% of the current building stock will still be with us in 2025. This makes it immediately apparent that the existing stock is a critical item in the nation's future. Additionally, more buildings are renovated than are built in a typical year, and in lean years, maintenance and alteration of the existing stock supports many of those not building new buildings.

A global research initiative has been set up to explore the issue of health in buildings with reference to World Health Organisation priorities and recommendations, and this warrants attention from New Zealand's research community.

The 2010 House Condition Survey (carried out every 5 years as part of a 20-year survey programme) jointly funded by BRANZ and the former Department of Building and Housing found that only 41% of houses were in good condition and well maintained, with 59% in moderate or poor condition. 25% of houses were in poor condition, having defects that needed attention within 3 months.

There is currently no comparable building condition data for non-residential buildings and only sparse data for rental properties. A past pilot study in small commercial buildings found that condition of buildings varied widely from building to building. Also, commercial buildings are substantially more complex systems than residential housing, both in terms of the physical buildings and the inter-relationships and division of responsibility for maintenance between landlords and tenants.





There is no evidence to suggest that this situation has changed or would not apply to a wider range of non-residential buildings.

Retrofitting the structure of existing buildings is more demanding than creating new buildings that are designed and detailed to current Code requirements. In retrofit work, it is necessary not only to ensure that new elements being introduced meet current Code requirements but that the remaining elements perform no worse than before the retrofit. In commercial buildings, retrofits can also trigger a requirement to upgrade fire and access provisions.

As the detailing of the existing structure is pre-determined and often unknown, solutions are required that do not place excessive demand on the capability of the existing structure. Rather than evaluate which retrofit solutions are best suited to different applications, research into gaining a better understanding of the integration of strengthening systems with the structure of existing buildings would be beneficial.

Research topics

Retrofit solutions

- What retrofit solutions are available to improve building resilience and performance?
- What are the tailored retrofit remedies for New Zealand's historic buildings, including unreinforced masonry, row buildings, early concrete construction, heritage and indigenous buildings?
- What situations are different solutions best applied to?
- What are the interactions between different retrofit methods, and what does this mean in the context of building systems?
- What is the value case for retrofit solutions?

Building condition

- What is the condition of New Zealand's commercial building stock?
- What is the condition of New Zealand's housing rental stock?
- How do we best improve the condition of New Zealand building stock?
- What are the priority areas for improving conditions?
- What are the barriers to improving building condition?

Links to other strategies and key documents

- [House Condition Survey](#)
- [Quality of Life in New Zealand's Cities project](#)
- [Toi Te Ora Housing and Health Report](#)
- [WHO Healthy Homes Sub-Programme](#)

Sustainability

The building and construction industry is a significant source of economic growth and prosperity.

According to the United Nations Environment Programme⁷, the industry accounts for 10% of the world's GDP and 7% of the world's jobs. However, to achieve this, the industry places high demands on the environment, being responsible globally for approximately:

- 40% of annual natural resource consumption
- 30% of energy consumption
- 30% of greenhouse gas emissions
- one quarter of all timber use.

In New Zealand, construction and demolition waste may represent up to 50% of all waste generated nationally⁸.

In New Zealand, commercial buildings account for around 9% of total energy use and 21% of New Zealand's electricity use, the latter of which costs New Zealand businesses around \$1.25 billion every year⁹.

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment report¹⁰ recognised that buildings represent the best opportunity to make significant reductions in greenhouse gas emissions while maintaining economic growth. The IPCC estimates

that, by 2022, CO₂ emissions from building energy use can be reduced by 29% at no net cost.

Internationally, governments are establishing policy to capture this opportunity. For example, the UK Government has already set out its policy that new homes will be carbon neutral from 2016. Given the resource-hungry nature of the building industry, sustainable building technologies provide a means to significantly reduce resource intensity, whilst still achieving high-quality built outcomes. The development of sustainable building technologies will mean that fewer and more sustainable resources will be used, more efficiently and with less pollution.

For New Zealand, sustainability issues remain important. Traditionally, 'sustainability' has been interpreted as 'environmental', but more recently, sustainability has been seen as being more than just environmental or energy issues.

Materials performance and sustainability are closely related, and there continues to be a need

to establish a reliable means by which materials can be compared on the basis of their contribution to sustainable development.

This is particularly important given the existence of the New Zealand Emissions Trading Scheme (NZETS). The current iteration of the NZETS expanded in July 2010 to include liquid fossil fuels, stationary energy and industrial processes. Waste and synthetic greenhouse gas sectors entered the scheme in January 2013, with the agriculture sector due to follow in January 2015.

As of 2015, the NZETS will impose obligations on practically all direct sources of greenhouse gas emissions.

The NZETS will have implications for the building and construction industry, and the scale of these impacts largely depends upon the choice of assessment methodology.

A purely emissions-based analysis could result in costly penalties for one product, for example, whereas a whole-of-life assessment approach for the same product in its end use may deliver a lower emissions profile

⁷ United Nations Environment Programme. 2010. *Education policy guidelines for sustainable built environments*.

⁸ Ministry for the Environment. 2007. *The New Zealand waste strategy: Towards zero waste and a sustainable New Zealand*.

⁹ Cutler, A. 2013. Educate about efficiencies in the built environment. *Element*, 7 June 2013.

¹⁰ Levine et al. 2007. Residential and commercial buildings. In *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*.



Owhanake Bay House, by Strachan Group Architects. Winner of a 2012 New Zealand Architecture Award. Photo: Patrick Reynolds.

than alternative products with lower manufacturing emissions.

The NZETS undergoes regular reviews (the government is currently consulting on whether to revise the Electricity Allocation Factor (EAF) to apply from 2013 onwards, for example); proactive participation in the review process and understanding the ramifications of each assessment approach will enable the industry to realise opportunities for using resources more efficiently while minimising their financial exposure.

The building and construction industry needs to better understand the implications of the NZETS across the building value chain and develop appropriate policy positions and adaptation and mitigation measures to ensure ongoing sustainability of the industry.

There is an underlying sentiment that a means of comparing the impacts of building materials during manufacture and how they contribute to building performance over the life cycle (including maintenance, replacement, and disposal/recycling/reuse) is needed.

This has been recognised overseas where schemes that recognise construction product environmental profiles and calculate environmental impacts of buildings continue to develop (for example, through tools

such as BRE Environmental Assessment Methodology or BREEAM in UK). International standards, protocols and guidance have been developed to enable comparisons to be fairly made in those countries.

A consistent framework for New Zealand is needed which considers product environmental profiling and environmental assessment of buildings across the life cycle.

Determining the energy consumption of New Zealand buildings (both due to their 'fabric' and also their use) continues as a long-standing need but is being well addressed by the past HEEP (Household Energy Efficiency Project) and existing BEES (Building Energy End-use Study) projects.

Research topics

Measuring sustainability

- What guidance, support and tools are needed in order to help industry to better understand and benefit from sustainability including benchmarking sector performance from a whole-of-life perspective?
- How best do we develop New Zealand-specific building and/or building project sustainability assessment tools that are soundly based in science and practices appropriate to this country?
- What level of information and analysis is required about the effectiveness of

resource amenities (such as energy and water use) in new and existing buildings?

New technologies

- How might the application of new technologies improve sustainability in new and existing New Zealand buildings?
- How does building design influence occupant behaviour towards or away from sustainable habits? What design features encourage or discourage occupants' resource use?
- How do we optimise and integrate multiple technologies and systems to maximise efficient resource use?

Links to other strategies and key documents

- Sustainable Built Environment Roadmap
- Household Energy End-use Project (HEEP)
- Building Energy End-use Project (BEES)
- New Zealand Environmental Profiling Plan



Photo: Michael Moran Photography.



Automation, industrialisation and new technologies

There is an increasing need in the industry for improved familiarity and competence with advanced manufacturing processes, management, quality control and emergent technologies that either support or disrupt the current methods and technologies in anticipation of improved productivity, improved quality, ease of use, control and other specific proprietary benefits.

New technology development is happening at an unprecedented pace, and we are starting to see how the power of technology can be applied to the building and construction industry and transform the way we work.

Pre-nailed frames and trusses are now commonplace in building. As technology continues to develop, there are likely to be more opportunities to utilise technologies and construction methods such as offsite manufacture

and prefabrication of components, panels, modules and complete buildings. These will help achieve efficiencies and improve productivity through, for example, consistency of quality and reduction of weather delays.



Building information modelling (BIM) and building environment information modelling (BEIM) have been promoted for a number of years, but recent rapid technology development and practitioner and client education has seen rapid growth in the uptake of BIM in the commercial construction industry especially. The application of BIM to date has highlighted the opportunities that BIM offers and the challenges to implementing BIM and realising these opportunities.

Product traceability is also important at a number of levels. For export industries, especially primary resources such as timber, traceability is becoming an increasingly important aspect of market access. Similarly, traceability is critical for products and materials making environmental or sustainability claims, as well as showing conformance with regulatory requirements.

Research topics

New construction systems and processes

- Modern methods of construction such as advances in offsite manufacture and prefabrication appear to offer benefits throughout the value chain, but are not being adopted as widely as anticipated.
- Which forms of technology are delivering the envisaged benefits, in terms of cost savings, labour efficiency and quality improvements?
- How do you upskill industry to adopt new construction systems?
- How do you change outdated perceptions of construction systems?
- What emerging technologies (offshore, onshore, within the industry, external) may have application in the building and construction sector?
- How can these technologies be developed for application in the building and construction sector?
- What are the most appropriate BIM standards for New Zealand?
- How can BIM best be applied to smaller building projects?
- How do we bring together BIM and BEIM? What are the current constraints, and how do we overcome them?

- How do we incorporate new technology developments into BIM/BEIM in a timely but managed way?
- What is the role of product traceability in the domestic market and in the international market?
- What are appropriate standards, benchmarks and protocols for the introduction of product traceability into conformance and regulatory processes?

Links to other strategies and key documents

- Productivity Partnership Research Action Plan
- NZ National BIM Survey 2012
- PrefabNZ Research Roadmap



LOD300 (Level of Development) BIM Model of Building 302 – University of Auckland
Image credit: Architectus and BECA

Operating environment

The operating environment is the external environment in which the building and construction industry operates and includes the regulatory environment (domestic and international) and the underlying economic conditions.

The Building Act 2004 is the primary legislation controlling building and building work in New Zealand, providing the regulation of building work, the establishment of a licensing regime for building practitioners and the setting of performance standards for buildings to ensure that:

- people can use buildings safely and without endangering their health
- buildings have attributes that contribute appropriately to the health, physical independence and wellbeing of the people who use them
- people who use a building can

escape from the building if it is on fire

- buildings are designed, constructed and able to be used in ways that promote sustainable development.

The building and construction industry has a large number of small and medium-sized enterprises. Therefore, legislation and regulation that govern the operation of small businesses (such as taxation and ACC) and how they impact on small business operations as well as how to manage a business are all important.

Export and import are very important for some parts of the industry, including the timber and steel subsectors.

Therefore, it is also important that legislation, regulation and agreements such as free trade agreements and biosecurity requirements enable a healthy and productive building and construction industry.

The importance of an operating environment that provides optimal conditions for effective market participation and activity underpins many other aspects of research.



Health and safety

In its May 2013 report, the Independent Taskforce on Workplace Health and Safety¹¹ found that approximately 10% of New Zealand's workforce was harmed at work in some way every year, resulting in 26,000 injury claims. With the construction sector collectively accounting for more than half of all workplace injury entitlement claims, this group was one of five industries (along with manufacturing, agriculture, forestry and fishing) that the Taskforce identified as particularly concerning.

Standards and conformance review

The Ministry of Business, Innovation and Employment is currently undertaking a review of New Zealand's standards and conformance infrastructure, with a specific focus on the standards system.

The outcome of the review will be proposals for an up-to-date, viable

and well functioning standards system that meets the needs of businesses, regulators and consumers in the foreseeable future.

Specific research needs and priorities identified as a result of this process will be reviewed and added to this strategy where relevant.

Building Act/Building Code

The Ministry of Business, Innovation and Employment is currently in the process of implementing a number of changes that the 2009/10 review of the Building Act 2004 identified as necessary in order to reduce costs and improve the efficiency of the building process.

Research topics

Export opportunities

- How can the construction industry capitalise on export opportunities, in terms of both products and knowledge?

Health and safety

- How do we improve industry health and safety without adversely affecting productivity and project costs?
- Understanding which health and safety measures work, and why.
- How do we improve health and safety performance in the DIY building sector?

Links to other strategies and key documents

- Building Act (2004) Review
- Productivity Partnership Research Action Plan
- Standards NZ Work Programme

¹¹ Independent Taskforce on Workplace Health and Safety. 2013. *The report of the Independent Taskforce on Workplace Health and Safety*, He Korowai Whakaruruhau.



Productivity

In August 2008, a taskforce was established by the Minister of Building and Construction with the intent of making recommendations on how to lift the declining productivity of the building and construction industry, paying particular attention to sector skills and procurement. The taskforce reported back in late July 2009 and made comprehensive recommendations on both those target issues and also wider ones impacting on the industry's productivity.

In 2010, the Building and Construction Sector Productivity Partnership, a joint venture between industry and government, was established through the then Department of Building and Housing to address low productivity in the industry.

Research shows productivity, or output per hour worked, in the industry is declining compared with construction industries in other countries and with most other sectors of the New Zealand economy. This poor performance has meant that the industry has become a drag on economic growth and performance.

A shared goal by industry and government through the Productivity Partnership is to improve construction industry productivity by 20% by 2020.

Working towards this goal requires an industry that is characterised by:

- a more knowledgeable client base that has better procurement skills
- vibrant firms capable of competing for projects as well as co-operating in partnerships, and effective supply network relationships
- resilient firms able to survive and grow through business cycles by effective business planning
- a flexible, safe and skilled workforce able to adapt quickly to new technologies and processes with significantly lower accident rates
- a clear, effective and responsive regulatory environment
- reduction of boom/bust cycles through co-ordination and forward

planning of central government and local government building programmes.

The importance of improving productivity in the building and construction industry was most recently highlighted by the government's Productivity Commission in its 2012 report into housing affordability. It remains a key issue of national importance, particularly given the rebuild challenge facing Canterbury and the forecast growth in population in the Auckland City region.

In 2012, the Productivity Partnership released its research action plan outlining the research required to underpin the attainment of a 20% productivity improvement by 2020. The Productivity Partnership also released a skills strategy that sets out the steps required to improve skills in the industry. The research priorities in this strategy have been drawn from this work.

Research topics

Industry structure

- A key starting point is to have a solid understanding of the New Zealand industry – in particular, what is distinctive about the New Zealand building and construction industry, how it is made up and the processes it uses.
- This information will in turn provide the basis for research into a number of different elements of the industry's productivity. It will provide insight

into the performance of the industry and the factors that may influence this – most notably in providing scope for comparative analysis of both similar industries and other economies.

Productivity measures

There is also a need for research to better understand how productivity can best be measured in relation to the various aspects of the industry – what are the best measures of industry productivity, company productivity, project productivity and task productivity?



Industry processes

Initial research carried out by the Productivity Partnership suggests there is significant variation in building and construction processes in New Zealand. This in turn suggests that performance across the industry is also likely to be variable. Research in this area should consider these aspects:

- What is stopping New Zealand industry from using more efficient construction processes?
- What are the drivers of innovation within the building and construction industry at sector, company and project level?
- What is the most effective way to spread innovation and productivity improvements throughout the building and construction industry?
- What is the impact of government procurement on industry productivity?
- How are activities such as the Christchurch rebuild influencing and changing procurement practices?
- What are the barriers to uptake of standardisation of building materials, products and building designs and how can it be made attractive?

Skills

One in every 12 workers in the New Zealand economy works in the building and construction industry.

The number of workers employed in the industry has declined by 16% over the past 4 years after increasing by around 70% in the previous 5 years, peaking in December 2006.

In 2010, economic activity in the industry represented 4.3% of New Zealand's GDP. This is considerably smaller than in other countries, with the building and construction industry representing 8% of GDP in the UK, 9% of GDP in the USA and 7% of GDP in Australia.

The industry is characterised by very small firms, with 91% of firms having five or fewer employees.

The industry also has a large proportion of sole traders, with 21% of workers being sole traders compared to 12% of workers across all industries in New Zealand.

The industry has workers with a wide range of skill levels. While more than 35% of workers in the industry leave school with no qualification and 25% of workers in the industry have no qualification of any kind, there are also many highly skilled professionals including architects, designers, engineers and surveyors.

A considerable challenge facing the industry in the short term is that, like many other sectors, the building and construction industry was adversely affected by the global financial crisis, and yet it is clear that substantial growth in work will occur over the next 5 years, with growth likely to accelerate through 2013 and 2014.

Repairing and replacing buildings and infrastructure following the earthquakes in Canterbury is going to generate a significant upswing in building and construction activity over the next 5 years. This, coupled with repairs needed to fix homes that have been identified as 'leaky buildings' and an upswing in

business-as-usual work due to pent-up demand, is going to cause the building and construction workload to rise sharply over the next 5 years. This will lead to demand for labour in the industry dramatically increasing over the same period.

There are important research questions about the skills of the industry:

- How does the construction industry skills profile change through the boom/bust cycle?
- What are the optimal trade skill sets and how are they best kept current?
- What is the optimal business/management skill set for the construction industry and how is it best kept current?

Technology

- What is the potential role for new and existing technologies to increase productivity?
- What can we learn from overseas about these technologies?
- What is the potential role for information technology in the NZ industry and how should it be introduced?
- What lessons for increasing productivity can be learned from other industries, such as the car industry, and applied to the construction industry in New Zealand?

Client value

- How can we help clients understand what's available and how to best meet their needs?
- How do we find out what clients value? What incentives are there for a home or building owner to improve the performance and resilience of their building? How does this differ across markets?
- How can whole-of-life value and multi-functionality be best factored into client decision-making?
- How can the knowledge of end-users as building users be utilised to evaluate performance and understand factors that contribute to success and failure of building use?



Operating environment

- What is the impact of regulation (e.g. the Building Act, Building Code and health and safety requirements) on productivity growth?
- How can new technologies help improve knowledge and the effectiveness of regulations and drive more efficient construction processes?
- How does the introduction of the LBP scheme improve the performance and quality of the final product?
- How will the dramatic shifts in insurance risk dynamics and labour market drivers affect industry and how will industry respond?
- How will contract and procurement strategies change in response to shifts in risk appetites and profiles?

Canterbury rebuild

- How are construction processes in the Canterbury rebuild changing as a result of the tight timeframes and special conditions?

- What is the change in mix of bespoke compared with standardised design and construction?
- How are uptake and integration of innovation changing during the Christchurch rebuild?
- How is the Canterbury rebuild changing the supply and demand for materials, skilled people and the skill level of construction workers?
- How will sector dynamics shift when responding to the rebuild and how

can we embed innovations and efficiencies from the Christchurch experience across the wider industry?

Auckland growth

- How are building types changing (e.g. detached housing to apartments)?
- How is building quality and fitness for purpose being addressed?
- What are the best residential building types for Auckland (e.g. mixed use)?

- Productivity Partnership Research Action Plan

- Productivity Partnership Skills Strategy

- Productivity Partnership Productivity Roadmap

- Productivity Commission: Housing Affordability Inquiry

- Christchurch Central Recovery Plan

- Auckland Plan





Meeting the housing needs of all New Zealanders

As New Zealand's population grows and changes so too do our housing needs.

It is forecast that New Zealand's population will reach 4.8 million people by 2021. But this growth is not expected to be distributed evenly amongst the regions – the populations of our cities are growing, particularly in the Auckland triangle (Tauranga, Hamilton, Whangarei). This will create particular pressures as housing markets change – some areas will face higher demand that could exacerbate existing affordability problems, while others may even see the housing market decline as the population falls in these areas.

The ethnic make-up of New Zealand's population is also changing, with the Māori, Asian and Pacific populations making up a growing proportion of the overall New Zealand population. This reflects past and likely future differentials in fertility, as well as the impact of intermarriage and changes in migration patterns. The cultural diversity of New Zealand's population will continue to increase, and this may also influence future housing needs; for example, if there is a demand for a greater multi-generational housing stock.

In the coming decades, median ages will rise across all ethnic groups, meaning an increasing proportion of people in the over 65 age groups. By 2051, there will be over 1.14 million people aged 65 years and over in New Zealand¹². This represents an increase of 715,000 or 166% over the base

(1996) population. They are expected to make up 25.5% (or 1 in every 4) of all New Zealanders (4.49 million). At present, there are about half as many elderly New Zealanders as children. By 2051, there are projected to be at least 60% more elderly than children. Given the prospects of sub-replacement fertility, increasing life expectancy and the passage of baby boomers into retirement age, it is projected that half of all New Zealanders will be older than 46 years by 2051, compared with the current median age of 34 years. The housing needs of an ageing population will not be met by current housing stock. Demand will increase for more liveable, lower maintenance homes. As people retire, employment will no longer tether people to particular places, and the drivers for choice of location will change. Many may choose to locate away from major centres of employment. For some, retirement at age 65 may not be desirable or feasible.

As the population changes, so too will the number of New Zealanders who may be experiencing some kind of vulnerability, either temporarily or permanently. As we think about the research needs in this area, there is also a need to consider the distinct housing needs of vulnerable groups. Some of these needs may be met through specialist housing provision, others through support in mainstream housing (with, for example care, and support services or through aids and adaptations).

These groups could include:

- families or individuals who are homeless or with support needs
- offenders and people leaving prison
- people with alcohol or drug problems
- people with HIV or AIDS
- people with learning disabilities
- people with mental health problems
- people with physical or sensory disabilities
- refugees
- women at risk of domestic violence
- young people leaving care.

The last decade has also seen changes in housing affordability, particularly for households looking to buy a home. Productivity Commission¹³ figures show the national house price to disposable income ratio rose from around 2 to 1 in 1980 to around 3 to 1 in 2003, before doubling to almost 6 to 1 in 2008. It is currently (2012) at around 5 to 1. Figures from the New Zealand Government Treasury¹⁴ also show the percentage of gross income required for an average mortgage payment grew from around 35% in the mid 1990s to a high of 65% in 2008 at a time when interest rates were around 10%. It is now around 45%. Housing affordability is a significant issue in many parts of the country, particularly in housing markets such as Auckland where pressures exist around both rents and home ownership.

Linked to changes in affordability has been the decline in levels of home ownership. In recent decades, home ownership was highest in the 1991

¹² Khawaja & Thomson. 2000. *Population ageing in New Zealand*. Wellington: Statistics New Zealand.

¹³ New Zealand Productivity Commission. 2012. *Housing affordability inquiry: Summary version of Report, March 2012*.

¹⁴ MBIE. 2013. *National science challenges. Potential challenges for consideration by peak panel: Inclusive, innovative and secure society*.



House for Five, by RTA Studio, winner of a 2013 New Zealand Architecture Award. Photo: Patrick Reynolds.

Census, at 73.8%. It has since declined to 67.8% in 2001 and 66.9% in 2006¹⁵. For Māori, the figures are much lower, with home ownership having fallen from 31.7% in 2001 to 30.1% in 2006.

In 2006, most households who did not own the dwelling they lived in made weekly rent payments (85.9%). A small proportion (12.7%) of households who did not own the dwelling they lived in occupied the dwelling rent free, while rental arrangements were not stated for the remainder (1.4%) of households who did not own the dwelling they lived in.

But the tenure picture varies across New Zealand. In 2006, of the regional council areas, the Tasman and West Coast regions had the highest proportion of owned dwellings. The Auckland region had the lowest proportion of owned dwellings, at 50.7%. In Auckland, only 25.8% of Māori owned their own homes in 2006.

Home ownership is also, not surprisingly, a tenure dominated by households with higher incomes.

In 2006, 61.2% of households who did not own the dwelling they lived in had a total household income of \$50,000 or less.

¹⁵ Statistics New Zealand. 2006. *Quick stats about housing*.

With more and more New Zealanders living in rental housing either as a positive choice or because they cannot access home ownership, the availability and quality of new and existing rental housing provision (both the stock and its management) is growing in importance. For example, the 2010 Statistics New Zealand General Social Survey highlights that people renting are more likely (53%) to report having one or more major problems relating to their house or flat than those in owner-occupied dwellings (28%).

Research topics

Population change

- How well do we understand the implications of New Zealand's changing population on housing provision?
- What impact could changing household formation patterns have on existing and future housing?
- How might internal and external migration impact on different housing markets?

Housing an ageing population

- What are the housing needs of an ageing population? How do they differ from the current housing stock?
- Impacts of internal and external migration and migration effects of an ageing population – where are people moving to and from and what

is the impact of this on demand for housing? How do housing needs differ between different communities?

- What is the impact of the growing cohort of 'asset rich, cash poor' on supply, demand and price of particular types of housing?

Housing a diverse population

- How well is our current housing stock catering for New Zealand's ethnic diversity?
- As levels of diversity change in coming years, what changes might be needed around the provision of housing?

Meeting the needs of vulnerable groups

- What are the current and forecast levels of housing provision for people with vulnerabilities?
- How well is this housing meeting the needs of its current and future users?
- How well are the needs of vulnerable groups being met by general needs/mainstream housing stock – both existing and new build?

Housing tenure

- Changing tenure structures – what are they and how do they affect the make-up of NZ's housing stock, both existing homes and new build?
- What are the implications of a greater role for the rented housing market, particularly in different parts of the country?

Housing affordability

- How do land prices affect affordability?
- What impact do local and national regulatory requirements have on the cost of housing?
- What opportunities are there for New Zealand to improve housing affordability?
- What roles does affordable (sub-market) housing provision play within this and how best can that be delivered?
- What are the short, medium and long-term implications of ongoing housing affordability issues (for example, increased revenue support for households, social pressures)?
- How can new approaches to building and construction support improved

housing affordability (for example, improved productivity through offsite construction, supply-chain innovation,

development of affordable materials and systems etc.)?

Links to other strategies and key documents

- Productivity Commission: Housing Affordability Inquiry
- Housing Shareholders Advisory Group report – Home and Housed: a Vision for Social Housing in New Zealand, August 2010.
- Final Report of the House Prices Unit: House Price Increases and Housing in New Zealand, DPMC, March 2008
- Ministry of Business, Innovation and Employment: Housing Pressures in Christchurch: A Summary of the Evidence



Building better cities and communities

When cities grow quickly, central and local government and business can struggle to build buildings and infrastructure that keep pace with the demands of population growth. By contrast, in slow-growing and declining cities, the challenge can be just as difficult in dealing with replacement and ongoing maintenance with stalled or falling tax/rates revenues.

Cities are home for most New Zealanders. They are central to our quality of life and much of our economic and cultural innovation. As such, thriving, sustainable cities and settlements are integral to New Zealand's long-term wealth and wellbeing. New Zealand is a highly urbanised country, with approximately 87% of our population residing in urban areas.

Over the next 20 years, it is forecast that 75% of new construction will be in Auckland or Christchurch. It is therefore critical that our understanding of high-performing urban environments reflects the importance of these habitats to our society and economy.

The nature of New Zealand cities looks set to continue to evolve as population changes begin to take hold – both in terms of sheer numbers and characteristics (such as age) but also in terms of changing expectations and aspirations.

Good urban design (the arrangement and design of buildings, public spaces, transport systems, services and amenities) is vital to achieving the liveable cities that we aspire to. The Auckland Plan has a vision of being the world's most liveable city. Achieving this vision while experiencing substantial growth will require step changes in urban design and planning.

The unique opportunity presented by the rebuild of Christchurch also provides an opportunity (as well as a significant challenge) to urban planners and other parts of industry with an interest in urban development. Important lessons could be learnt from the rebuild that have application across New Zealand.

Research topics

- How do we deliver cities that meet the aspirations of residents, are affordable and liveable, while at the same time increasing density?
- What role can the built environment play in contributing to cities that support New Zealand's international competitiveness?



Photographer John Suckling – Re:Start's first anniversary, October, 2012.

- How can buildings enhance vibrant city environments?
- How is the Christchurch rebuild changing attitudes and approaches to urban revitalisation, and how can we apply these lessons elsewhere?
- How do we integrate urban planning requirements at a city level with individual property rights?
- What kind of medium and high-density housing is best suited to New Zealand's social, economic and environmental conditions?
- How best can we create neighbourhoods, towns, cities and regions that work for current and future needs, given that the majority of future buildings and infrastructural assets are already in place?

Links to other strategies and key documents

- Auckland Plan
- Christchurch Central Recovery Plan
- Quality of Life in New Zealand's Cities Project
- Building Competitive Cities: Reform of the Urban and Infrastructure Planning System
- Auckland Research Programme: Auckland Policy Office (formerly the Government Urban and Economic Development Office GUEDO)



Appendix A: Funding and implementation

Funding building and construction research

Industry, MBIE and BRANZ have worked in partnership to produce this strategy to help guide government and industry investment in building and construction research.

Research is funded and managed by a range of organisations, including individual firms, industry bodies, research organisations and government, with MBIE being the primary government investor and BRANZ the primary industry investor. Each agency is responsible for managing and prioritising its own research funding.

By identifying and setting out the strategic research needs of the industry across all areas, this strategy can be used by each funding agency to develop and co-ordinate work programmes that will complement each other and contribute to understanding all aspects of building and construction research.

What Building a Better New Zealand provides:

1. Guidance to organisations that fund building and construction research. The direction provided in the strategy allows these organisations to consider research proposals against the priorities for research identified by the industry.
2. Guidance to researchers when considering building and construction-related research topics and preparing expressions of interest for research funding.

Information on the funding requirements and process for MBIE can be found at www.mbie.govt.nz.

Information on the funding requirements and process for BRANZ can be found at www.branz.co.nz.

Implementation

As well as providing a research work programme to supply direction to researchers and research funders, the strategy has the related goals of:

- improving the dissemination of research results
- ensuring the quality of research results
- maintaining and developing New Zealand's research capability.

Work will begin in 2013 on implementing the strategy, including integrating it with other building and construction-related research programmes and developing an integrated publications and dissemination programme for building and construction research.

In delivering this strategy, New Zealand researchers should draw on and contribute to international best practice, both in terms of research methods as well as learning from and leveraging research carried out in other countries. While New Zealand has its own distinct characteristics that shape our approach to building and construction, we can also benefit considerably from drawing on applicable research from international research groupings like the International Council for Research and Innovation in Building and Construction (CIB), as well as specific national institutions such as the National Institute of Standards and Technology (NIST), USA, the Building Research Establishment (BRE), UK, and Sustainable Built Environment National Research Centre (SBEnc), Australia.

It is expected that the strategy will continue to be refined over 2013–14, with a final strategy in place by the end of 2014. The final strategy is expected to have a 5-year life.

Disclaimer

The Ministry of Business, Innovation and Employment (MBIE) was formed on 1 July 2012, bringing together four separate government agencies into one ministry.

MBIE's purpose is to be a catalyst for a high-performing economy to ensure New Zealand's lasting prosperity and wellbeing.

The Infrastructure and Resource and Markets Group within MBIE is the primary arm of government charged with administering the Building Act (2004) and working with the construction sector to ensure New Zealand has safe and healthy buildings that enable an innovative and productive economy. As such it works with the sector to help establish a research strategy that identifies the key research areas that are needed to achieve this goal.

Note that this support does not imply that funding from the Science, Skills and Innovation Group within MBIE is or will be available to address this research strategy or that it would be prioritised above similar strategies developed by other sectors with support from their relevant government agencies.

MBIE's Science, Skills and Innovation Branch is the primary agency responsible for the government's investment in research and technology across the whole economy. The Research, Science and Technology Act 2010 requires decisions on proposals for specified funding to be made by independent boards established for this purpose. This process is independent and impartial across all sectors regardless of which government agency is supporting the particular sector's strategy.

Appendix B: Acknowledgements

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Appendix C: Links to other strategies and documents

Auckland Plan

<http://theplan.theaucklandplan.govt.nz/>

Auckland Research Programme: Auckland Policy Office (formerly the Government Urban and Economic Development Office GUEDO)

<http://www.apo.govt.nz/ViewPublication.aspx?id=3>

Building Act (2004) Review

<http://www.dbh.govt.nz/buildingactreview>

Building Competitive Cities: reform of the urban and infrastructure planning system

<http://www.mfe.govt.nz/publications/rma/building-competitive-cities-discussion-document/index.html>

Building Energy End-use Study (BEES)

www.branz.co.nz/BEES

Canterbury Earthquake Research Strategy (supplement to the Research Strategy of the Natural Hazards Research Platform)

<http://www.naturalhazards.org.nz/NHRP/Canterbury-Earthquake-Research-Strategy>

Canterbury Earthquakes Royal Commission Reports

<http://canterbury.royalcommission.govt.nz/Commission-Reports>

Cement and Concrete Association Research Strategy (under development)

<http://www.ccanz.org.nz/>

Christchurch Central Recovery Plan

<http://ccdu.govt.nz/>

Department of Building and Housing: Using the Product Assurance Framework (2010)

<http://www.dbh.govt.nz/UserFiles/File/Publications/Building/Compliance-documents/Product-Assurance-Framework-guidance.pdf>

EQC Research Strategy

<http://www.eqc.govt.nz/research>

Final Report of the House Prices Unit: House Price Increases and Housing in New Zealand, DPMC, March 2008

<http://www.dPMC.govt.nz/dPMC/publications/hpr-report>

Fire Research Roadmap

http://www.branz.co.nz/cms_show_download.php?id=14aacaf7f41077bc32d12d1438a40a2e1044993e

HERA Annual Report 2012

http://www.hera.org.nz/Category?Action=View&Category_id=416

House Condition Survey

http://www.branz.co.nz/cms_show_download.php?id=53af2b0c2e5ca5169a0176996bba7ee88de082c0

Household Energy End-use Project (HEEP)

www.branz.co.nz/cms_display.php?sn=18&st=1&pg=7655

Housing Shareholders Advisory Group report – Home and Housed: A Vision for Social Housing in New Zealand, August 2010.

<http://www.dbh.govt.nz/UserFiles/File/Publications/Sector/pdf/vision-for-social-housing-nz.pdf>

Ministry of Business, Innovation and Employment (MBIE): Housing Pressures In Christchurch: A Summary of the Evidence, 2013

<http://www.dbh.govt.nz/UserFiles/File/Publications/Sector/pdf/christchurch-housing-report.pdf>

New Zealand Environmental Profiling Plan

http://www.branz.co.nz/environmental_profiling

New Zealand Forest and Wood Products Industry Strategic Plan

<http://www.woodco.org.nz/strategic-plans>

New Zealand Metals Engineering Industry Position on Public Policy Issues 2012

http://www.hera.org.nz/Product?Action=View&Product_id=239

New Zealand National BIM Survey 2012

<http://www.masterspec.co.nz/news/reports-1243.htm>

PrefabNZ Research Roadmap

<http://www.prefabnz.com/News/Roadmap/>

Productivity Commission: Housing Affordability Inquiry

<http://www.productivity.govt.nz/inquiry-content/1509?stage=4>

Productivity Partnership Productivity Roadmap

<http://www.buildingvalue.co.nz/publications>

Productivity Partnership Research Action Plan

<http://www.buildingvalue.co.nz/publications>

Productivity Partnership Skills Strategy

<http://www.buildingvalue.co.nz/publications>

Quality of Life in New Zealand's Cities project

<http://www.qualityoflifeproject.govt.nz/>

Research Strategy of the Natural Hazards Research Platform

<http://www.naturalhazards.org.nz/>

Standards NZ Work Programme

<http://www.standards.co.nz/development/Standards+New+Zealand+Work+Programme/default.htm>

Structural Performance of Christchurch CBD Buildings in the 22 February 2011 Aftershock: Report of an Expert Panel appointed by the New Zealand Department of Building and Housing

<http://www.dbh.govt.nz/UserFiles/File/Reports/quake-final-expert-panel-report.pdf>

Sustainable Built Environment Roadmap

http://www.nzgbc.org.nz/index.php?option=com_content&view=article&id=121&Itemid=233

Toi Te Ora Housing and Health Report

<http://www.toiteorapublichealth.govt.nz/vdb/document/65>

Weathertightness, Air Quality and Ventilation Engineering programme (WAVE)

http://www.branz.co.nz/cms_display.php?sn=137&st=1

WHO Healthy Homes Sub-Programme

http://www.who.int/healthy_settings/types/homes/en/index.html

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