CURRENT BRANZ SCHOLARSHIPS

Automation, industrialisation and new technologies

Jack Steele

Victoria University of Wellington, Masters

Project timeline: 2019-2020

Methods and requirements for reliable building performance simulation

Jack's research work is focussing on enabling bidirectional interoperability of Computer Aided Design (CAD) and Building Energy Modelling (BEM) models. BEM environmental assessment programs exist, but they are not in forms which industry practitioners can easily use. These advanced simulation programs can be linked together with a Visual Programming Language (VPL) so that users don't have to learn or make individual models for each analysis program. Jack will develop a Graphical User Interface (GUI) to a workflow using a VPL to conduct different environmental simulations. Designs throughout the development process can be tested to evaluate their performance compared to code minimums and alternative designs that would include design improvements. This work acts as a proof of concept in two growing areas, BIM (Building Information Modelling) and visual scripting of Building Performance.

Gerard Finch

Victoria University of Wellington, PhD

Project timeline: 2018-2021

Prefabricated architecture for a circular materials economy

This PhD research is developing innovative construction methods to eliminate waste. The building industry is the biggest contributor to landfill: for every five dwellings, the equivalent of one more is sent to landfill as overruns, offcuts and damaged materials. Gerard's research aims to 'design waste out' at the outset of building work, addressing which materials are specified, and how these are cut, shaped, formed, assembled and fixed. From that point he is investigating economic constraints affecting proposed alternative construction methods, which include eliminating composite materials, developing re-usable structural components, and making best use of prefabrication and off-site manufacturing.

Armano Papageorge

Victoria University of Wellington, PhD

Project timeline: 2018-2021

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

Armano's previous research recognised the value of mass customisation, using advances in software technology to produce different types of items with different specifications within similar

timeframes, cost margins and resources expenditure. His current project will take advantage of these new technologies to redefine automation and industrialisation in New Zealand's building sector, specifically evolving methodologies into a system which could be applied to full scale residential homes. The work will be done in conjunction with Callaghan Innovation, whereby Callaghan will provide access to the 5-axis gantry robot and material extruder, and Armano will develop mass customisation and structural optimisation software. Armano expects to use this innovative 3D concrete construction printer to demonstrate means of producing higher quality buildings and building components for lesser time and cost, whilst also addressing matters of waste mitigation and climate responsiveness.

Better buildings

Karin Henshaw

University of Otago, Masters

Project timeline: 2019-2020

Public housing transitions

Karin's research is looking at longitudinal outcomes for tenants who repeatedly enter and exit HNZC tenancies with a view to understanding the drivers, associated outcomes and longer-term health, employment and social functioning effects of repeated residential transitions within public housing. The work picks up findings from the 2016 Industry Needs Survey which cited inadequate knowledge around meeting housing needs and the requirement for strategies to build better cities and communities. Karin will examine how the operations of NZ's public housing system can affect long-term adult tenant health and employment and long-term child tenant social functioning.The work is also connected to other He Kainga Oranga work on the impact of buildings on society, where public housing is part of a wider policy agenda covering housing provision, security of tenures, and mixed-tenure communities.

Louise Bullen

Massey University, Masters

Project timeline: March 2019 – May 2020

Future life-cycle-based environmental impacts of NZ's grid electricity

Louise is researching models used to measure buildings' future greenhouse gas impacts. As NZ is aiming at a net zero carbon economy, a better understanding of how different consumption scenarios affect carbon intensity will allow evaluation alongside other strategies such as improved energy efficiency and low-carbon construction schema for buildings.

Buildings use a significant amount of energy during their lifetimes, most of this derived from grid-supplied electricity. Establishing the environmental impacts of this electricity use as accurately as possible into the future supports more accurate evaluation of the whole life cycle impacts of buildings. This work has particular significance given potential greenhouse gas trade-offs between energy efficiency improvements for buildings and changed future electricity mixes. MBIE will use this research to model future electricity demand and related environmental impacts. EnviroMark Solutions NZ already use carbon footprint as an element of certification schemes and are looking to develop life-cycle-based accounting for future electricity use. Transpower will use this research to provide insights into the environmental footprint of NZ's electricity grid infrastructure.

Nicole Allen

University of Canterbury, PhD

Project timeline: April 2018 – August 2020

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

Volcanic hazard impacts to buildings are comparatively understudied compared to seismic and weather hazards but do pose considerable risk to New Zealand. This work is a disaster risk and resilience project of empirical research using purpose-built equipment and aiming to improve the understanding of the building industry and the resilience of building elements in particular. Given that Auckland's volcanically active history indicates the need for preparation against future eruptions, this work will both inform the means of providing stronger buildings and greatly assist future evaluations of habitability of housing stock during and after volcanic eruptions. This includes effects on essential services such as electricity and water reticulation and sewage disposal. Being able to carry out accurate habitability assessments is particularly important given that volcanic events can be both long-term and sequential and may necessitate very wide scale (potentially hundreds of thousands) housing evacuations. The challenges of widespread building damage and the complexities of housing a large and distressed displaced population cannot be underestimated.

Jono MacIntyre

University of Canterbury, PhD

Project timeline: January 2018 – December 2020

Defining equivalent fire severity for structural applications

Jono's research is establishing a robust method to determine fire severity effects on structural elements aside from, and alternative to, current time equivalence methods. This will lead to a means for fire engineers to better determine the structural severity of a particular fire and will also help develop construction methods to make buildings more resilient to fire hazards. These improved methods will contribute towards developing probabilistic structural fire design techniques, allowing for better calculations of design requirements for the determined level of fire resistance and levels of safety achieved by as-built systems and, by removing unknowns, allow the cost of constructing buildings to higher levels of fire performance to be reduced.

Beth Noble

Victoria University of Wellington, PhD

Project timeline: October 2017 – October 2021

Designing artificial lighting systems that meet the needs of people on the autism spectrum: an evaluation of the effects and investigation of design solutions

Beth's PhD research is a development of her Masters studies. The New Zealand Building Code outlines the importance of a built environment that is accessible to people of all abilities and function. Lighting contributes a major sensory input to indoor environments and can affect aspects of everyone's health. Colour, hue, brightness, glare, directionality, sub-visual flicker and type can all produce physical effects on wellbeing and comfort. A significant proportion of survey respondents in Beth's earlier studies identified being subjected to artificial lighting as a major issue for people on the autism spectrum. Lighting was cited as creating discomfort and distress, likely to set off avoidance behaviours, negatively affect cognitive abilities and task performance, and possibly act as

an employment barrier for people on the autism spectrum. This work will contribute to improving indoor building performance for this group and for all users.

Dan Court-Patience

University of Canterbury, PhD

Project timeline: January 2017 – April 2020

Predicted performance of connections in diagonal Buckling Restrained Braced (BRB) frames designed in New Zealand

Dan's research work has progressed from Masters level. He is working to provide predictive evidence, via tested computer simulations and reliable, replicable models, to act as guidance for the design of connections in buckling-restrained-braced frames, especially for ground storey installations where risk of failure is highest.

Buckling-restrained-braces ('BRBs') are a new seismic device with no existing evidence of their actual performance as part of a full structure during a major earthquake event. As the cost of experimental testing is very high, Dan's work is developing computer modelling and simulations as an alternative to supplement experimental tests. These realistic simulations can then be used to accurately predict and quantify the BRBs performance under a variety of loading scenarios. Dan's research is producing peer-reviewed published papers covering his testing results and recommendations for future designs.

Julia Thompson

Victoria University, PhD

Project timeline: March 2015 - March 2018

Natural ventilation of spaces for large audiences

Julia's research looks at how to design fresh air systems for spaces that cater for large audiences. The Opera House in Wellington has been selected as a case study for this research due to its impending seismic renovation, as well as its original naturally ventilated design. This includes a sliding ceiling and sliding roof system. This case study project aims to understand the principles used in the design of the original natural ventilation, and their performance in practice. As well as recovering lost knowledge, research in this area has the potential to create solutions to improve building performance during seismic retrofit of unreinforced masonry buildings, with the opportunity to also restore their functional heritage.

Phoebe Taptiklis

Massey University, PhD

Project timeline: March 2015 – April 2019

Assessing the relative impact of poor home maintenance on interior dampness

Phoebe's project contributes to the on-going investigation into the contribution that small improvements to the housing stock make to reducing dampness and mould in New Zealand houses. This project builds on the work of the BRANZ House Condition Surveys and the research of the Household Injury Prevention Study. These respectively showed the poor condition of claddings and the contribution this has to dampness and poor health. This project aims to identify ways to reduce

mould and dampness and hence improve the health of occupants and durability of the housing stock.

Peter Marriott

University of Canterbury, Masters

Project timeline: February 2016 – June 2019

Limits of applicability of commonly used fire models in fire safety design

Peter is investigating the limits of applicability of commonly used fire models in fire safety design. Through finding these limits the research aims to develop design guidelines for fire models of large rooms with relatively small fire growth. These design guidelines will combine with the already extensive design guidelines to create robust and reliable modelling of fire in buildings in New Zealand. This will help Fire Engineers to undertake better, more efficient design which in turn will lead to improved public safety.

Materials performance

Audsley Jones

University of Canterbury, PhD

Project timeline: February 2013 – September 2019

Self-centring dual-steel frames using Buckling-Restrained-Braces ('BRBs')

Audsley's research has been looking at the behaviour of buckling restrained braces, compositionally and in interaction with surrounding members. From her analysis, design guidelines will be developed for engineers to design buckling restrained braces, the connections and the surrounding members. A testing protocol will also be introduced for buckling restrained braces designed outside the scope of the guidelines.

Sustainability

Sanjeev Ganda

Victoria University of Wellington, Masters

Project timeline: March 2018 - July 2019

Life cycle environmental impact assessment of residential building thermal envelopes

Sanjeev's work is focusing on the environmental impact of buildings. Buildings which incorporate 'sustainable', 'energy efficiency' or high-performance features or systems are often lauded because of their low impact on the environment, typically because they use low amounts of operational (running) energy. This research looks more deeply into whether these residential buildings that use low energy actually are truly environmentally friendly. Using Life Cycle Assessment (LCA) is the ideal technique for this hypothesis as it covers the design of residential building thermal envelopes with standard and high-performance construction systems and considers the whole life cycle, so there is no risk that a perceived environmental saving in one part of the life cycle does not inadvertently lead to an increased environmental impact in another. Similarly, it can ensure that savings in one environmental impact are not inadvertently made at the expense of increases in other environmental impacts. Use of LCA in ascertaining whether designs are truly sustainable in the long

term is particularly important where a greater proportion of modern building materials originate outside the country in which they are finally used in building.

Emily Newmarch

Victoria University of Wellington, Masters

Project timeline: March 2018 - May 2019

Performance of thermal envelopes in NZ extreme climates

Emily's work is an integration of the fields of architecture and building science, aimed to assist both architects who currently shy away from energy, thermal and life cycle performance evaluation due to constraints with time, cost, and additional training, and the public-audience everyday New Zealand consumer who is seeking to understand what 'code minimum' is and the potential benefits of exceeding it. The 2016 Industry Needs Survey suggested a level of architects' frustration around seeking information to complete tasks which often comprise large amounts of tedious and repetitive work, particularly that relating to code compliance when ensuring designs comply with minimum standards. This research addresses this through design-led workflow streamlining covering important areas such as energy efficiency in buildings, envelope ventilation, high performance housing and thermal bridging, and proposes to give priority to energy efficiency in buildings by emphasising the transition between a building information model (BIM) to a building energy model (BEM). The one-dimensional calculations for HAMT (Heating and moisture transmission) in thermal envelopes are an example, wherein the common response is to explore solutions to the problem architecturally through alternative design details. However, industry standard methods of calculation do not allow for ready estimation of the performance of design details, and architects are unlikely to use more complex calculation methods on a regular basis. This research is therefore looking to explore the performance of the thermal envelope in two different architectural scenarios to determine what level of analysis might be sufficient for architects wishing to push the boundaries and regularly build better than code minimum. The result will be adjusting the default architectural practice formula of design, develop, detail, to readily and routinely include energy evaluations.

Rochelle Ade

University of Auckland, PhD

Project timeline: February 2017 – February 2020

Actual performance of Homestar rated homes

Rochelle’s work will compile a database that will allow the water and energy use of New Zealand homes to be benchmarked against each other as well as determining IEQ performance. This will in turn enable analysis of the performance of Homestar rated houses and compare it to the predicted performance in the Homestar Rating Tool. By understanding what guidance, support and tools are needed it will look to help industry better understand and benefit from sustainability including benchmarking sector performance from a whole-of-life perspective. Rochelle’s research also hopes to establish benchmarks of IEQ performance that could be used as a threshold to determine if a dwelling has acceptable IEQ performance.

Operating environment

Andrew Walmsley

Massey University, PhD

Project timeline: March 2018 – February 2021

Men's health and suicide prevention - investigating help-seeking behaviour among men within the construction industry

Current research shows that construction industry workers have elevated levels of depression and anxiety, which have known associations with (to name a few) decreased job satisfaction, memory difficulties, lack of concentration, fatigue and decreased productivity. These are among key risk factors for suicide. Inability to concentrate can also affect ability to follow instructions and make decisions and increase the likelihood of workplace injuries and/or accidents. The 'macho' culture amongst some groups of men (manifested as a strong sense of pride, an exaggerated masculinity not depending on others, displaying little weakness or emotions other than anger, not cooperating with authorities, demanding respect at all times, and suffering pain in silence) means that the danger to health and safety from psychological stress is often ignored. Andrew's research will explore health and safety processes responsive to men's specific needs and develop understanding about factors which could facilitate help-seeking among men within the construction industry: particularly, what type of information men need or want, where they prefer to seek help, and the best ways for managers to encourage employees, and workers to encourage their fellows to seek help for psychological distress.

Recent Alumni

Completed in 2019

Sandi Sirikhanchai

used her VUW studies to address the issue of the time series demand/supply relationship between building energy generation, building energy demand and peak demand in the electricity grid. She investigated the use of building energy demand schedules such as reducing energy demand for a set period of time and found that buildings could be used to support the grid by balancing supply and demand. This could reduce the need for investment in new resources and materials for large-scale energy sources and grid infrastructure.

Vicky Southworth

used her Masters research at the University of Canterbury to investigate water sensitive urban design ('WSUD') uptake in urban areas. She found that local authorities were much more likely than private owners to install WSUD features such as rain gardens. The 'existing (urban) hydro-social contract' means that stormwater is seen as a waste to be moved rapidly off site and into the council managed stormwater system, rather than a resource which private owners can manage and use on their own properties. Also, some property owners who did attempt to apply WSUD thinking by adding rain tanks and rain gardens to properties at the construction stage found that building rules required non-standard building and site plumbing to accommodate these which councils did not necessarily understand or support.

Jarred Butler

used his VUW Masters research to investigate how well simulation software and data from the Housing Condition Survey ('HCS') could predict mould growth in bathrooms. However, his pilot study results did not align with the HCS data and subsequent detailed data analysis ruled out any role of assumptive data in this result. His subsequent parametric study was unable to generate artificial risks of mould so the role of mitigation strategies in the first results could not be tested. He concluded that the HCS data was non-useful for simulation software and a long-term controlled environment would be required to provide a reliable testbed.

Kimberley Russell

conducted project research which demonstrated the significant role of procurement methods in projects' abilities to meet the three aspects of the time, cost, and quality triple constraint. When comparing procurement systems implemented within BIM projects, innovative procurement methods appeared to produce more successful project outcomes. However, whilst innovative methods better support the collaborative working relationships which BIM implementation requires, they also come with high up-front costs and so are typically implemented only in large, complex or bespoke projects. Kimberley recommended that a further investigation into the selection processes of traditional procurement and underlying contracts would establish how best to align BIM processes with traditional procurement.

Glen Stricot-Tarboton

delivered a VUW Masters of Architecture proof-of-concept project to design and assemble building panels using an ABB robotic arm. Glen wrote a series of digital scripts which programmed the robot to pick up, cut, place and nail a prefabricated timber frame, changing between multiple tools throughout, and completing a range of panels including variously shaped timber frames with plywood lining and those with multiple layers of components including rigid air barriers, cavity battens and weatherboard cladding. The culmination stage used the robot arm to produce all of the 28 unique panels (walls, roofing and flooring) required for a small building.

Mikayla Heesterman

completed her Masters of Architecture project at VUW using an ABB robot arm to develop customisable timber joints for mass construction. Timber's material capacity and the limitations of fabrication machinery have restricted the use of timber as structural elements in the past; Mikayla's designed interlocking joints are intended to facilitate using more timber as structural building elements. Using the robot arm means that complicated undercuts and decorative elements suitable for construction elements can be produced on a large scale. Alongside other developments in engineered timber and design and fabrication tools, this work demonstrates new opportunities for the use of structural timber in ways which were previously thought impossible or inefficient.

Tayler Hubber-Davis

investigated integrating building information modelling ('BIM') with augmented reality ('AR') using a Microsoft Hololens. Whilst BIM has had considerable uptake recently, the full potential for using AR to support BIM has yet to be explored. Portability is the key attribute of an AR headset, making it uniquely useful in construction as most workers need a view of the spaces or buildings to perform their everyday tasks; BIM and AR used together could help manage on-site activities through providing instant feedback on design decisions and plans. Tayler's VUW Masters research found that while AR delivered better visual understanding than traditional paper methods, test groups using a laptop detected problems faster than those using solely the AR headset or sets of paper plans. This outcome was attributed to greater familiarity with the laptop than the headset, and the study also found that while paper plans were the most familiar resource, they were also the slowest and least

efficient to use. Tayler's recommendation was that training builders in new technologies such as the AR headset would definitely deliver on-site building information benefits and that the groups lacked familiarity rather facility in applying the AR headset to the test tasks.

Olivia Whyte

has a background in Geography and Planning. Her Masters in Planning work at Otago investigated whether co-housing could form an alternative to conventional detached homes and thus provide some relief to housing supply. She used extensive interviews to review how Earthsong (an established co-housing community) and Dunedin's High Street Cohousing Project (in process) both provided for high-quality passive housing and quality of life and social interactions for residents; processes for collective decision-making which were both supported and supportive were a particular interest.

Mike Bedford

completed his PhD supervised by the University of Otago, investigating temperatures, air quality and infectious disease incidence in childcare facilities. He noted that the NZ standards for space allocation in childcare is one of the lowest in the OECD and that the NZ minimum temperature standard is the lowest, two degrees below the recommended WHO level of 18 degrees for homes and workplaces. Mike tracked childcare attendance, parents' lost work time, sleep room temperatures, and air quality. He found an average of 7.8 sick days per child and recommended raising the minimum air temperature as well as investigating better, more efficient heating systems for centres, such as infrared heating and/or air curtains.

Past Alumni research projects

Agneta Ghose

Life cycle assessment (LCA) as a tool to evaluate strategies for reducing environmental impacts arising from refurbishment of New Zealand offices

Amber Garnett (nee Mellor)

Assessing water footprint and associated water scarcity indicators at different spatial scales: case study of concrete manufacture in NZ

Amber Haddock

Current practices in asset and facilities management, can BIM be an improved solution for asset management?

Anne Ryan

Targeting productivity: Enabling the successful adoption of Building Information Modelling (BIM) and Integrated Project Delivery (IPD) in the NZ construction industry by maintaining the relevance of procurement systems and contracts

Brian Berg

Early design stage embodied energy assessment simplification

Brian Guo

The development of construction safety indicators for the NZ building industry

Cara Askew
Building management systems: Defining user perceptions and processes within New Zealand's existing non-residential building stock

Elzine Braasch
The specification of a performance sketch model for thermal and daylight performance analysis in the early stages of design using detailed complex modelling simulation programs

Ethan Duff
Parametric modelling of energy conservation measures and associated internal environmental quality metrics on small commercial Buildings in New Zealand

Funmi Rotimi
An evaluative framework for defects in new residential buildings: A case for New Zealand

Garry Miller
Methods of improving productivity in construction & engineering: Information flow and innovation

Harriet Peel
Engineering basis for reaction to fire properties of internal surface linings

Jade Kake
Pehiaweri B1B papakāinga: A model for culturally appropriate housing in Te Tai Tokerau

Johannes Dimyadi
Automated audit of Building Information Models against New Zealand standards

Kara Rosemeier
Detailed definition of the reference standard (Building Code) and energy efficiency standard in the respective climate zones

Karn Henning-Hansen
Delivering better, more varied types of housing for an aging population, focusing on sustainable models, and simultaneously addressing the need for increased urban density and infrastructural repurposing

Lee Bint
Water performance benchmarks for New Zealand: Understanding water consumption in commercial office buildings

Manfred Plagmann
Increasing the ventilation rate and temperature in NZ junior classrooms using a solar roof collector

Mariana Esteves
Assessment of building material attributes: a comparative study between eco-labelled and non-eco-labelled products

Mark Hinton
Achieving collaborative advantage in the construction industry supply chain

Michael Anderson
Investigation into Green Star building user guides and how consumers can access building information in terms of readability and usability

Penny McGowan
A thermal model for a solar ventilation system used in NZ schools

Philip Penn
How detailed a BIM model needs to be to obtain accurate material qualities for houses

Priyanka Raina
A rational basis for setting up a monetary retention regime for construction contracts

Sally Coughlan
New Zealand small to medium sized enterprises (SMEs) in the construction sector: Barriers to engagement with environmental profiling and development of potential solutions

Samia Ali Tariq
High volume utilization of glass wastes in the composition of concrete including self-compacting concrete

Sara Wareing
The evaluation of a range of existing NZ housing warrant of fitness tools to determine if their estimations of thermal performance are reliable and accurate measures of actual thermal performance

Tavis Cresswell-Wells
Passive commercial buildings and urban form in the Christchurch rebuild

Van Tran
The economic value of a zero-waste policy for construction materials in New Zealand

Victoria Toner
A predictive outdoor tool for thermal comfort

Wajiha Shahzad
Comparative analysis of the productivity levels achieved through the use of prefab systems with those of the traditional construction methods: case studies of some projects in Auckland

Wu Ruqun (Susie)
New Zealand small to medium sized enterprises (SMEs) in the construction sector: Barriers to engagement with environmental profiling and development of potential solutions

Yasmine Merwood
New Zealand sound insulation regulations in an international context

Yusef Patel
Increasing value in the building industry by the use of digital fabrication

Zubin Karami
Durability performance of polyurethane bonded wood joints for the NZ industry