Te Kāhui Whaihanga New Zealand Institute of Architects

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John Syned
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Ministry of Business, Innovation & Employment

Attention:
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Tēnā koutou,

RE: TE KĀHUI WHAIHANGA SUBMISSION – BUILDING CODE UPDATE 2021

About Te Kāhui Whaihanga New Zealand Institute of Architects

1. Thank you for the opportunity offered to Te Kāhui Whaihanga New Zealand Institute of Architects to make a submission on *Building Code Update 2021*

2. The Institute has been in existence since 1905 and is the professional body representing more than 90 per cent of New Zealand's registered Architects and many recent graduates entering the profession. In total the Institute represents over 4,300 members. The Institute is active not only in advocating in the interests of our members, but also in promoting practices and providing education and promoting industry wide cooperation that will improve the quality and sustainability of New Zealand's built environment.

3. The Institute has, through its governance structure and membership, significant professional experience in the New Zealand construction industry. That experience includes a wide variety of projects across all construction types and scales. The Institute also has more than a century of experience assisting our members and their clients with projects at all stages, from project establishment and concept design through to contract administration and site observation.

4. The objects for which the Institute is established include the promotion of excellence in architecture, improvement of the technical knowledge and professional development of persons engaged in the practice of architecture, and bringing to the attention of central and local authorities any matters affecting architecture or architects.

5. Accordingly, Te Kāhui Whaihanga supports the Government initiatives to update and modernise the Building Code provisions. We do, however, wish to draw the Government's attention to several potential issues arising from the proposals included within the Bill as outlined below.

6. Te Kāhui Whaihanga would welcome the opportunity to engage with officials and other industry professions on the issues raised in our submission. It will be important that any potential regulatory change is co-designed between industry and Government to ensure that the changes are practical and pragmatic.

7. Thank you for the opportunity to provide feedback on the Building Code Update 2021. Should you have any questions about this submission, please contact Te Kāhui Whaihanga's Chief Executive Teena Hale Pennington on thalepennington@nzia.co.nz.

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SPECIFIC RESPONSES

Question 1-1

Climate zones

Expanding the number of climate zones from three to six begins to acknowledge the range of climates that are experienced in New Zealand, but it is difficult to understand how the various regions have been grouped together to form the larger climatic zones.

For example, Hokitika has an average rainfall of between 3000mm and 4000 mm and an average mean temperature of 10˚C, and it is now grouped in the same climate zone as Rotorua, which has an average rainfall of between 1250-1500 mm, and an average mean temperature of 14˚C.

Tauranga is grouped in the same zone as Whangārei, and Hawke's Bay is grouped in the same zone as New Plymouth, yet each region experiences very different climatic conditions.

As discussed in this submission, increasing insulation thickness does not directly correlate to a warmer, drier, or healthier home. A region divided by a mountain range can experience significantly different climates on either side and, while the number of climatic zones is proposed to increase, the climatic zones are too generalised, and do not consider the microclimates that exist within individual regions or even individual sites.

Recommendation:
The Institute would encourage the Government to undertake further work on creating a climatic map and zones that can be supported by a clear standard and methodology. Any mapping will be indicative and used only as a reference when calculating site-specific temperature and climatic conditions or only in the absence of more reliable data being available. This approach would be consistent with the mapping of wind zones.

Increase in R-values

The proposed R-value options illustrated in figures 1.3A to 1.3D of the Consultant Document, *Building Code Update 2021* (**consultant document**) bring into sharp relief how far behind Australia, California, England, Ireland, and Wales (**comparable overseas countries**) our mandatory R-values are. The difference is highlighted by comparing Dublin and Dunedin, which have similar climates.[1] In Dublin, a new home requires an R-value of 6.1 and in Dunedin, a new home requires an R-value of 3.3, despite the mean temperatures in summer and winter being very similar.

As early as 1940, the New Zealand Government **(Government)** knew the ceilings and walls of more than 50% of new dwellings contained mould. The research at the time concluded that the solution was to increase both thermal insulation and ventilation.[2] Despite the research and regional efforts to reduce air pollution,[3] it was not until 25 November 1977[4] that the government made insulation in new homes compulsory.

[1] David Hindley, 'NZ vs Ireland building regs' (*Build*, 1 December 2020) <http://www.buildmagazine.org.nz/index.php/articles/show/nz-vs-ireland-building-regs> accessed 24 May 2021.
[2] Nigel Isaacs, 'Thermal insulation required in New Zealand homes' (*New Zealand History*, 1 April 1978) <https://nzhistory.govt.nz/page/thermal-insulation-required-nz-homes> accessed 24 May 2021.
[3] In 1971 Waimairi County, on the northern fringes of Christchurch, because the first local authority to implement a thermal insulation by-lay in an effort to address the region's recurring air pollution problems. https://nzhistory.govt.nz/page/thermal-insulation-required-nz-homes
[4] Nigel Isaacs, 'Thermal insulation required in New Zealand homes' (*New Zealand History*, 1 April 1978) <https://nzhistory.govt.nz/page/thermal-insulation-required-nz-homes> accessed 24 May 2021.

Since 1977, the R-value has only increased to an R-value of 3.3 in New Zealand's coldest zone despite this early research and the impact of damp, mouldy and poorly ventilated homes on the respiratory health of many New Zealanders.

The research continues to be ignored by the Government despite the overwhelming health benefits of improving a home's thermal performance and indoor air quality. A BRANZ survey in 2015 found 40 percent of homes in New Zealand were considered damp and mouldy[5] and in 2017 the OECD found New Zealand's homes are poorly constructed and heated, and our standards are considered less stringent than those of comparable OECD countries.[6] The latest BRANZ research released in May 2021 has found that 60 percent of the 2000 children surveyed who were living in homes that had poor air quality or where it was either too cold or too humid, experienced poor health.[7]

The Government must do better and New Zealand must do better. As a country, we cannot afford to continue to make minor, disparate changes to the Building Code that continue to maintain the status quo, which amounts to failing our most vulnerable people. We must get to the core of the issue, which is the health and wellbeing of all New Zealanders. The Government can act boldly, and it did so in 1984 when Prime Minister David Lange banned nuclear-powered or nuclear-armed ships from using New Zealand ports or entering New Zealand waters. The health of New Zealanders is today's nuclear-free moment. The Government does not need to commission more reports, it simply needs to implement the findings of past reports and raise the performance and indoor air quality of our future homes by choosing **Option 3 – Going Further**.

Option 3 proposes the highest R-values of the three options presented by Government, however it still falls short of the R-values of comparable overseas countries. While the title 'going further' suggests the Government is being ambitious, Option 3 continues New Zealand's poor track record. Within this option, only the proposed R-values of roof insulation,[8] windows to climate zone 3 and 4, and wall insulation to climate zone 6 'go further'.

To highlight how low Option 3 is, if a new home were constructed in Canberra, which has a higher average mean temperature than Auckland, the new home in Canberra would be required to have a higher R-value than a home built in New Zealand's coldest zone.

If the New Zealand government is serious about constructing warm, dry, and healthy homes, the proposed Building Code changes should match the highest R-values of the comparable overseas countries. Australia, England, and Wales are proposing their own Building Code changes, and soon New Zealand will fall further behind international standards if we do not act quickly to dramatically modernise our Building Code.

While an increase in insulation is required to a) achieve our carbon goals, b) to construct buildings that are warmer, drier, healthier, and more efficient, and c) help reduce our current carbon budget,[9] simply considering a one-dimensional view of clause (H1) in isolation may have an adverse effect on other areas and will not be something that will affect real change. A building is a sum of its parts and it is these parts that create performance outcomes.

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[5] BRANZ, 'House conditions survey 2015' (*BRANZ*, 2015) <BRANZ Housing Condition Survey 2015.> accessed 27 May 2021

[6] OECD, 'OECD Environmental performance reviews New Zealand 2017' (*Environmental Defense Society*, 2017) <OECD (2017), OECD Environmental Performance Reviews: New Zealand 2017, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9789264268203-en.> accessed 24 May 2021

[7] Jamie Morton, 'World-first study: nearly half of NZ kids sleep in cold bedrooms' (*NZ Herald*, 25 May 2021) <https://www.nzherald.co.nz/nz/world-first-study-nearly-half-of-nz-kids-sleep-in-cold-bedrooms/YFVQHNEVJRUYMNM6WD7YF33MA4/> accessed 25 May 2021

[8] The roof insulation in Option 3 in all six climatic zones achieves or betters the R-value of the comparable countries.

[9] Based on Massey University and BRANZ research, the current carbon budget for each new stand-alone house has been calculated to be 39 tonnes CO_2. A typical standalone home in New Zealand is typically just less than 200m2 gross floor area and is designed to be just compliant with the Building Code has a carbon footprint of almost seven times higher than the carbon budget. Refer to http://www.buildmagazine.org.nz/assets/PDF/Build-177-35-Design-Right-Design-To-Cut-Carbon-The-Time-Is-Now.pdf?

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At a simplistic level, increasing the R-value (which measures how well insulation can resist heat flow) should lead to a warmer building. However, it is understood that by increasing the thickness of the insulation, the existing dew point is likely to move, which could facilitate the accumulation of moisture within the wall system. This may lead to damage or rot if inadequate consideration is given to the infiltration of air and the movement of vapour.

Recommendation:
The Institute strongly urges the Government to match the highest R-values of the comparable overseas countries. In addition, any change to H1 needs to consider thermal modelling, elimination of cold bridges[10], air tightness, robust detailing, increased observation of construction work and onsite testing.

Performance based metric

The proposed changes to H1 do not align with Government's *Building for Climate Change (**BfCC**)* report, released in August 2020. The changes to H1 concentrate on an increase in the R-values whereas the BfCC proposes a performance-based metric (kWh/m^2 of heating demand).

By being prescriptive (i.e., specifying R-values), the Building Code is deviating from its original intent, which was to be a performance-based code designed to address the wellbeing, sustainable development and health and safety of building users. The code was originally written to allow flexibility and encourage innovation by specifying the functional requirements and performance criteria for building work, as opposed to prescribing how a building is to be built.

Recommendation:
The proposed changes to H1 should reflect the underlying logic of the Building Code (i.e., performance-based) and incorporate the internationally recognised method of designing for a maximum energy performance standard (kWh/m^2). The benefit of a performance-based metric is that it will incorporate factors that are not currently being included such as air infiltration and thermal bridging[11], which can have a significant effect on a building's thermal performance.

On-site performance testing

A 2010 report commissioned by the Energy Efficiency and Conversation Authority (EECA) identified a 100% failure rate in the quality of insulation installation. The failures included gaps in the insulation underfloor (67%), in the walls (95%) and the ceilings (91%), and damaged insulation in the walls (13%) and ceilings (24%) and areas of the façade where insulation was missing entirely (36% of walls and 77% of ceilings).[12]

A series of house condition surveys were carried out by BRANZ and the results identified several hidden problems including missing, compressed, damaged and damp insulation.[13] The effect of missing insulation or even insulation that is poorly fitted is significant. A 16mm gap between the edge of the insulation and its timber framing can reduce the overall system R-value by 48%.[14]

[10] Recent research by BRANZ has confirmed that the average residential house has a timber frame wall area of 34% which is approximately double the timber framed wall area when calculating the system R-value using the currently accepted method of calculation.
[11] Recent research by BRANZ has confirmed that the average residential house has a timber frame wall area of 34% which is approximately double the timber framed wall area when calculating the system R-value using the currently accepted method of calculation.
[12] Beacon pathway limited, 'Thermal insulation in New Zealand homes: A Status Report' (*Beacon Pathway*, 2008) <https://www.beaconpathway.co.nz/images/uploads/Final_Report_TE210_Thermal_Insulation_in_NZ.pdf> accessed 26 May 2021
[13] Ian Cox-smith, 'Is thermal insulation performing?' (*Build*, 1 June 2013) <https://www.buildmagazine.org.nz/index.php/articles/show/is-thermal-insulation-performing> accessed 25 May 2021.
[14] NZS 4246:2016 Energy Efficiency - Installing bulk thermal insulation in residential buildings.

As discussed previously, an increase in R-values should make a house warmer, but simply mandating an increase in R-values without addressing quality assurance may void any benefits of increasing the R-value.

Recommendation:
The Institute would encourage the Government to require a) modelled testing data to be submitted alongside of consent documentation and then verified with onsite performance testing (supported by a Government funded and resourced quality assurance/audit programme).

Modelled and measured data is key. It provides an overall perspective on the quality of construction and importantly it becomes an incentive for ongoing improvement, particularly across designers and contractors. There is nowhere to hide when you have the numbers.

For this approach to be successful the Government needs to ensure a sustained investment in construction industry education, data modelling tools (which must be freely available) and a commitment to measurement and evidence. The Building Levy should be prioritised for this investment and it needs to start now.

Air tightness and on-site air testing

The infiltration of air through a building's façade reduces the building's thermal performance (H1) and allows moisture to be carried into the building's fabric, exacerbating the wetting that occurs and, crucially, remaining in the fabric where it can cause mould and rot. BRANZ has identified that 49% of buildings in New Zealand have visible black mould growth, which is a good indicator of hidden interstitial mould growth.[15]

Belgium, the Czech Republic, Denmark, Estonia, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, and many states in the USA use air pressure testing as a means of assessing the energy efficiency and health of a building. Air pressure testing became mandatory in Britain in 2020.[16]

In New Zealand, little to no attention is given to creating airtight buildings, and airflow is likely to occur through a series of intentional and unintentional entry points, such as light switches, power outlets, recessed lighting, plumbing fixtures, and gaps between linings, which contribute to the underperformance of any installed insulation. The permeability of a building is relatively simple and inexpensive to test during construction and the mandatory requirement of blower door tests can assist in creating more airtight buildings. It also provides perspective on the overall quality of construction for contractors. Importantly the information can become a strong incentive for improvement.

The Fraunhofer Institute of Building Physics has shown that reducing infiltration has a significant impact on the energy efficiency of a building envelope. Just a 1mm gap in a 1 x 1 m section of wall was shown to increase the U-value (1/R-value) from 0.3 $W/(m^2 \cdot K)$ to 1.44 $W/(m^2 \cdot K)$.[17]

Constructing buildings that are airtight increases their energy efficiency. The increase in efficiency was highlighted by the Passive House Institute, which modelled the heating demand for houses located in Auckland, Wellington, and Christchurch with three levels of infiltration, from one to five air changes per hour.

[15] Ministry of Business Innovation & Employment, 'Airtight buildings causing moisture issues' (*Building Performance*, 21 February 2020) <https://www.building.govt.nz/assets/Uploads/bctrag/bctrag-february-2020-airtight-buildings-causing-moisture-issues.pdf> accessed 25 May 2021.
[16] Ministry of Business Innovation & Employment, 'Airtight buildings causing moisture issues' (*Building Performance*, 21 February 2020) <https://www.building.govt.nz/assets/Uploads/bctrag/bctrag-february-2020-airtight-buildings-causing-moisture-issues.pdf> accessed 25 May 2021.
[17] Pro clima, 'A New Zealand based study on airtightness and moisture management' (*Pro Clima*, 2020) <https://proclima.co.nz/wp-content/uploads/2020/08/pro-clima-Study-Airtightness-Moisture-Management-2020.pdf> accessed 25 May 2021.

The energy savings made by increasing the house's airtightness and thus reducing the number of air changes from five to one per hour, were 11 kWh/m^2.a in Auckland, 16 kWh/m^2.a in Wellington, and 19 kWh/m^2.a in Christchurch.

Recommendation:
The Institute would encourage the Government to adopt an increase in airtightness requirements, which could be verified on-site by a simple and inexpensive blower door test. This would have a significant impact on the energy demands of our buildings, improve occupant health and productivity, and increase a building's durability and longevity.

Question 1-2

The New Zealand Government must actively upgrade the Building Code to reduce the health effects New Zealanders experience as a result living in poorly performing buildings, and to reduce emissions to meet our climate change targets.

As demonstrated by BRANZ, the current carbon footprint for a typical home constructed today is almost seven times higher than our carbon budget. The time to act is now - we cannot continue taking a 'business as usual approach' to the construction and operation of our buildings and expecting other areas of the economy such as transport and agriculture to make up the difference.[18] While the reduction of our carbon footprint is important, the focus on carbon should not distract from the Government's primary priority which is the health and wellbeing of New Zealanders.

Question 1-3

To ensure New Zealand's future homes are warm, dry and healthy, the Government must set out a clearly defined roadmap with interim targets that are aligned to the Government's Building for Climate Change framework to allow the construction industry time to progressively adapt.

For example, Energy Step Code Aotearoa with Primary Energy (ESCAPE) which is made up of developers, engineers, architects, Government, contractors, and material suppliers, has proposed future projects to help the construction industry identify what action is required and when. The following table from ESCAPE sets out the savings required and the target year.

Target Year	Total Usage Intensity (kWh/(m^2.a)	Thermal Energy Demand Intensity (kWh/(m^2.a)
2023	175	60
2026	150	45
2029	100	30
2032	75	15

The improvements to H1 proposed by Government should only be viewed as a step towards achieving an energy threshold of 15 kWh/(m^2.a) and as part of a much wider movement towards a more sustainable New Zealand.

[18] Dr Dave Dowdell, 'Design to cut carbon – the time is now' (*Build*, April 2020) <http://www.buildmagazine.org.nz/assets/PDF/Build-177-35-Design-Right-Design-To-Cut-Carbon-The-Time-Is-Now.pdf?> accessed 25 May 2021

For example, in their submission to the Climate Change Commission in March 2021, Associate Professor Michael Jack of the University of Otago, Professor Janet Stephenson and Dr Ben Anderson showed that a performance increase in New Zealand's housing could cut winter peak energy demand by up to 80% and flatten seasonal demand peaks, which in turn will help reduce New Zealand's infrastructure spend.[19]

As identified in Question 1-1, an increase the R-value is a step towards improving the Building Code, however, it is only one part of the thermal performance matrix that must be considered. No consideration in the Government's proposals has been given to improving air tightness, reducing cold bridging, or defining a minimum performance requirement for indoor air quality (ventilation, heating, humidity, and carbon dioxide).

Question 1-4

Option 3 is the only option than can sensibly be chosen despite this option solely focusing on insulation which, as discussed in 1-1, will do little to improve the thermal performance of a new home. For the reasons detailed in this submission, a wider review of a building's thermal performance must be carried out before any changes to the Building Code are made.

Question 1-5

As identified in the consultant document, the changes proposed by Government will require an additional investment of between 4.15% and 12.1% in each new home and this will be unpalatable to some in an already stressed industry. Research carried out in the United Kingdom suggests the increased costs following a building code update do fall; by 2014, the cost of building to the Zero Carbon Standard for homes in the United Kingdom had fallen by half from the cost estimates published in 2011.[20]

This increase in costs will likely fall over time and be offset by an improvement in the health of New Zealanders, a lowering of our carbon footprint and the construction of homes that are more energy efficient, warmer and drier. An overall performance increase will help to reduce the $7 billion dollar burden on New Zealand's health system by reducing respiratory illnesses such as asthma, which are directly attributed to the poor indoor air quality of New Zealand homes.[21]

Question 1-6

Prior to any update of the Building Code, Government needs to be clear in what it is trying to achieve. For example, the proposed Building Code update does not align with the Building for Climate Change framework.

The introduction in British Columbia of a step code has demonstrated that when the industry is given time, is set performance targets, and is provided with adequate education and support, a governments targets will be met. The construction industry in New Zealand is part of a larger global industry and can look to overseas countries to either borrow or help develop the strategies and practices required to deliver the targets before they become mandated.

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[19] Professor Michael Jack, 'Single Idea: Decarbonising NZ's energy system through demand-side intervention' (*University of Southampton Institutional Repository*, 26 March 2021) <https://eprints.soton.ac.uk/448287/1/NZCCCSubmission_Jack_et_al.pdf> accessed 25 May 2021

[20] Zero carbon hub, 'Cost analysis: Meeting the zero carbon standard' (*Zero Carbon Hub*, 2017) <https://www.zerocarbonhub.org/sites/default/files/resources/reports/Cost_Analysis-Meeting_the_Zero_Carbon_Standard.pdf> accessed 25 May 2021

[21] Dr Caroline Shorter, 'Study shows mould in bedrooms causes asthma in young children' (*University of Otago*, 2017) <https://www.otago.ac.nz/news/news/otago661987.html> accessed 25 May 2021