BUILDING PERFORMANCE

Background paper

Building Code fire safety review

Issues in the Building Code regulations

October 2024

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

Ministry of Business, Innovation and Employment (MBIE)

Hīkina Whakatutuki – Lifting to make successful

MBIE develops and delivers policy, services, advice and regulation to support economic growth and the prosperity and wellbeing of New Zealanders.

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Introduction

This background paper is an appendix to the discussion document

This background paper contains additional technical information that supports the main discussion document. It contains:

- information on the development of building regulation and the Building Code,
- lists of stakeholder meetings and feedback received as part of this review,
- summaries of historical fire events in New Zealand and overseas,
- previous reports prepared on the Building Code in New Zealand and the fire safety provisions,
- comparisons to international building codes,
- a full list of issues by topic and descriptions identified as part of this review, and
- photographs throughout to illustrate the relevant discussion points.

How to use the background paper

These technical appendices are in four main parts: Appendix A, B, C, and D.

In Appendix D you will find an overview of the issues found. Under each issue you will find one or more references with a 3-letter prefix and a number. The links to these references can be found in appendices A. B and C in this background paper.

While technical in nature, the sections on historical fire events (Appendix B) and the issues identified (Appendix D) may be of interest to all readers.

Prefix	Type	Section	Description	
SRG	Stakeholder	A.2.1	Stakeholder Reference Group	Indicates which stakeholder(s) raised the issue
STM	Stakeholder	A.2.2	Other stakeholders providing feedback in meetings and emails	Indicates which stakeholder(s) raised the issue
STF	Stakeholder	A.2.3	Stakeholders providing feedback in emails only	Indicates which stakeholder(s) raised the issue
HFE	Historic Fire Event	B.1	Past fire events in New Zealand and overseas which have shaped past regulations, and which highlight specific challenges for certain buildings.	Links a past fire event to the issue
R	Report	B.2	Past reviews of the fire safety provisions in the Building Code in the past 30 years	Link to any reports relevant to the issue
NCC	International Building Code	C.3	Australian National Construction Code 2022	Link to a relevant section or topic in an international building code
ICC	International Building Code	C.4	International Code Council	Link to a relevant section or topic in an international building code
NFPA	International Building Code	C.5	National Fire Protection Association NFPA 101 2024	Link to a relevant section or topic in an international building code
NBCC	International Building Code	C.6	National Building Code of Canada 2020	Link to a relevant section or topic in an international building code
BR	International Building Code	C.7	United Kingdom Building Regulations 2010	Link to a relevant section or topic in an international building code
WB	International Building Code	C.8	World Bank Building Code Checklist for fire safety	Link to a relevant section or topic in an international building code

Contents

Appendix A. Further information on the background and methodology

A.1 Making changes to the Building Code system

A.1.1 Regulations are made by Order in Council

The mandatory Building Code requirements are set in regulation. This is Schedule 1 of the Building Regulations 1992. The Building Code is secondary legislation made by empowering provisions in the Building Act in section 400 the Building Act.

A.1.2 MBIE publishes acceptable solutions and verification methods

MBIE develops acceptable solutions and verification methods that can be used to demonstrate one way to comply with the Building Code.

In order to develop these documents, MBIE must follow the procedures and processes outlined in the Building Act namely sections 29 and 30. There are sections of the Act that also must be followed including the content of acceptable solutions and verification methods and the incorporation of material by reference.

A new proposed change to the Building Act regarding the specification of building products may also inform how MBIE develops these documents in the future.

A.1.3 The discussion document is the first phase to making regulatory changes to the Building Code

The release of the discussion document for review forms the first phase of this work where MBIE have identified issues in the Building Code.

Phases 2 and 3 will include:

- proposals or options for new or revised settings in the building code for public consultation, and
- an assessment of potential implications for the relevant documents that may be used to demonstrate compliance with the building code.

Timelines for the review will depend on the information received in this year's consultation and any new or emerging issues along the way.

A.2 Potential issues in the Building Code

A.2.1 Stakeholder Reference Group members provided feedback

Between May and July 2024, MBIE sought feedback from its Fire Regulatory Review Stakeholder Reference Group. This group consists of 13 members representing organisations in the New Zealand building and construction sector and other groups that benefit from a modern and fit-for-purpose building code framework.

Each organisation was asked to get feedback from their members and submit this to MBIE. Several organisations elected not to provide feedback at the time. Issues identified by the Stakeholder Reference Group are in Appendix D.

A summary of the Stakeholder Reference Group members is provided in the table below.

ID	Organisation
SRG 1	Auckland Council

ID	Organisation
SRG 2	Building Officials Institute of New Zealand (BOINZ)
SRG 3	BRANZ
SRG 4	Concrete New Zealand
SRG 5	Fire and Emergency New Zealand (FENZ)
SRG 6	Fire Protection Association New Zealand (FPANZ)
SRG 7	Home Owners and Buyers Association Inc. (HOBANZ)
SRG 8	Institute of Fire Engineers (IFE)
SRG 9	Registered Master Builders
SRG 10	Society of Fire Protection Engineers New Zealand Chapter (SFPE NZ)
SRG 11	Steel Construction New Zealand (SCNZ)
SRG 12	Te Kahui Whaihanga New Zealand Institute of Architects (NZIA)
SRG 13	Wood Processors and Manufacturers Association (WPMA)

A.2.2 Other stakeholders also provided feedback in meetings and emails

Between April and July 2024, MBIE also sought feedback from other stakeholders on issues in the Building Code. This included Government agencies, local councils, product manufacturers and suppliers and other industry professionals.

In total there was feedback from 21 different meetings and 20 pieces of feedback received via email. Issues identified by the other stakeholders are included in Appendix D. A list of meetings is shown in the table below.

ID	Organisation	Date	Format
STM 1	PFITS - Passive fire, fire engineering, inspections, and training services	2024-04-08	In person
STM 2	Government Property Group	2024-04-09	Virtual
STM 3	Insurance Council of New Zealand - Te Kāhui Inihua o Aotearoa	2024-04-09	Virtual
STM 4	Te Uru Rākau - New Zealand Forest Service	2024-04-10	Virtual
STM 5	Te Whatu Ora - Health NZ	2024-04-17	Virtual
STM 6	University of Canterbury - Fire Engineering Group	2024-04-18	In person
STM 7	Mainland Group of Building Consent Authorities	2024-04-29	Virtual
STM 8	Architectural Designers New Zealand	2024-05-07	Virtual
STM 9	Kāinga Ora - Homes and Communities	2024-05-07	Virtual
STM 10	MBIE Disabled People’s Advisory Group	2024-05-20	Virtual
STM 11	Metro Group of Building Consent Authorities	2024-05-23	Virtual
STM 12	Department of Corrections - Ara Poutama Aotearoa	2024-05-24	Virtual
STM 13	EBOSS Suppliers network – Internal surface finishes and cladding	2024-05-28	Virtual
STM 14	EBOSS Suppliers network – Passive fire protection	2024-05-30	Virtual
STM 15	Tech Coatings	2024-06-05	In person
STM 16	Whaikaha - Ministry of Disabled People	2024-06-13	Virtual
STM 17	WorkSafe New Zealand Mahi Haumaru Aotearoa	2024-06-20	Virtual
STM 18	Terra Lana	2024-06-24	In person
STM 19	Ministry of Education school design team	2024-06-26	Virtual
STM 20	WorkSafe New Zealand Mahi Haumaru Aotearoa	2024-07-08	Virtual
STM 21	University of Canterbury Fire Engineering Structural fire performance group	2024-07-16	In person

Items received via email are listed below.

Appendix A. Further information on the background and methodology

ID	Organisation	Feedback	Format
STF 1	Government Property Group	Building Performance Specifications for New Government Office Accommodation Buildings v2013.10 updated August 2018	Document
STF 2	Government Property Group	Building Performance Specifications for Existing Office Buildings, v2013.10 updated August 2018	Document
STF 3	Government Property Group	Universal Design Guidelines, June 2023	Document
STF 4	Government Property Group	DRAFT Building Performance Specifications for Government office accommodation buildings	Document
STF 5	Selwyn District Council	Follow up to Mainland group, 2024-05-03	Email
STF 6	Interni Interior Contracting	C/AS2 Improvements, 2024-05-28	Email
STF 7	Advance Flooring	Questions for MBIE workshop and feedback from	Email
STF 8	CarterHoltHarvey	Fire Safety NZBC, 2024-05-28	Email
STF 9	Autex	Feedback on fire safety issues, 2024-05-29	Email
STF 10	LMATimber	Fire compliance workshop Session 2 and feedback submission, 2024-05-31	Email
STF 11	Allegion	Fire safety review, 2024-06-26	Email
STF 12	Winstone Wallboards	Fire safety issues, 2024-06-26	Email
STF 13	Hilti	NZBC C3 review feedback, 2024-06-28	Email
STF 14	Department of Corrections - Ara Poutama Aotearoa	Feedback	Email
STF 15	Kāinga Ora	Fire Regulatory Review: Kāinga Ora Stakeholder feedback	Email
STF 16	Metro Sector Group	Building Code fire review Metro Sector Group final 8th July	Email
STF 17	WorkSafe New Zealand Mahi Haumaru Aotearoa	MBIE notes from informal meetings – WorkSafe tracked changes	Email
STF 18	Alzhemier's NZ	Feedback about fire safety	Email
STF 19	Wellington City Council	Building Code Fire Review WCC Submission	Email
STF 20	New Zealand Police Ngā Pirihimana O Aotearoa National Property Office	NZ Police Determination Letter	Email

Appendix B. Lessons learned from the past

B.1 Fires have occurred in New Zealand in all types of buildings

This section of the appendix contains examples and summaries of fires that have occurred in New Zealand and overseas. The earliest fires expanded our knowledge of fire behaviour and have help shaped Building Codes and standards over the past 100 years. The more recent fires highlight specific challenges facing modern buildings.

Data on these events is from:

- Summaries of investigations provided by FENZ.
- Fire and Emergency Fire Research and Investigation Unit Heads up articles available online from https://www.fireandemergency.nz/research-and-reports/heads-up/.
- The National Fire Protection Association Fire Protection Handbook 19th Edition (2008) namely:
    - Cote, A. E., & Grant, C. C. (2008). Codes and Standards for the Built Environment. *Fire protection handbook*, section 1.3
    - Hall, J., & Cote, A. E. (2008). An overview of the fire problem and fire protection. *Fire protection handbook*, section 3.1.
- 111emergency.co.nz which contains photographs from over 500 fire events and training exercises in New Zealand over 30 years.
- Newspaper articles, investigation reports, and other sources available online as noted.

Photos provided illustrate some of the fire phenomena and challenges in firefighting for residential buildings and urban environments. Photos are primarily in the Wellington area but there are photos from stretching across both islands and into rural communities. These illustrate that fire is a problem faced by all communities across the country. We selected photos of fires in New Zealand where no serious injuries or deaths were reported.

We want to acknowledge the devastating impact of these fires have on people, their whanau, and communities and offer condolences to anyone who was affected by these events.

B.1.1 Early fires in New Zealand shaped codes and standards

These fires informed several of the early city ordinances, municipal bylaws, and early standards used to regulate fire safety in New Zealand including the model building bylaws NZS 95 and NZS 1900.

HFE 1 – 1848 – Government House, Auckland – Government house was destroyed by a fire which was thought to have been originated in a chimney[1]. No one was injured in the fire.

HFE 2 – 1858 – Auckland – 50 houses were destroyed by a fire in one the oldest and most closely-built parts of the city[2]. This was the first of many 'great fires' of Auckland which resulted the destruction of multiple buildings.

[1] Daily Southern Cross, Volume 3, Issue 157, 24 June 1848, Page 2. Accessed online from: https://paperspast.natlib.govt.nz/newspapers/DSC18480624.2.7

[2] Taranaki Herald, Volume VI, Issue 312, 24 July 1858, Page 1 (Supplement). Accessed online from: https://paperspast.natlib.govt.nz/newspapers/TH18580724.2.18

HFE 3 – 1864 – Christchurch – On 4 June, a fire occurred in the city centre and spread between several closely built wooden houses resulting in the destruction of about ten buildings[3].

Following this fire, Christchurch passed an ordinance to require new buildings in the city centre to have external walls of 'brick, stone, or other incombustible material' and roofs made of 'slates, tiles, metal' or other material similarly fire-proof'[4]. This ordinance also applied to public houses and communal lodging houses. It is unclear how these buildings performed in subsequent earthquakes in Christchurch such as the 1888 North Canterbury earthquake.

HFE 4 – 1863 and 1866 – Auckland – Entire blocks of Queen Street were destroyed by fires.[5,6]

HFE 5 – 1872, 1873, 1876 – Auckland – About 100 buildings were destroyed by these fires.[7,8] There were several reported injuries. Multiple Government buildings were destroyed which had to be moved to temporary offices. There were concerns raised on the ability of firefighters to respond effectively due to the height of the buildings and lack of water supply. In 1876, the few remaining wooden structures in Queen Street burned down[9].

HFE 6 – 1879 – The Octagon – Dunedin – A fire broke out at a café and quickly to several other properties in the same building. The fire blocked off the single central stairwell and escape from the building was difficult. Twelve people died[10]. This was single biggest loss of life in a fire in New Zealand for the next six decades.

HFE 7 – 1901 – Grand Hotel – Auckland – A fire in this hotel resulted in five deaths including three children. There were issues evacuating the building and multiple people jumped from the upper levels to the ground. The building was destroyed by the fire.

HFE 8 – 1907 – Fire at Parliament buildings – Wellington – A serious fire destroyed most of the Parliament Buildings[11]. The original building was a two-storey wooden building. The fire was probably started by a short in the electric wiring in the ceiling. It spread rapidly through the old wooden parts of the buildings and then into the masonry additions of the 1880s. The library had been saved only by its fire walls and metal fire door. This was not the last time there would be a fire at Parliament. During the 1992 refurbishment of the Parliament buildings, there were three different fires that occurred (see Figure 1). The first occurred on the penthouse of Parliament House. The most serious was in the library causing damage to the staircase, stained glass, and roof. All of the modern parliament buildings now have smoke detectors and sprinklers.

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[3] Lyttelton Times, Volume XXI, Issue 1249, 14 June 1864, Page 2. Accessed online from: https://paperspast.natlib.govt.nz/newspapers/LT18640614.2.3
[4] Isaacs, N., "Early building legislation", BRANZ Build Magazine, 122, 90-91, February/March 2011.
[5] Taranaki Herald, Volume XI, Issue 549, 7 February 1863, Page 4. Accessed online from: https://paperspast.natlib.govt.nz/newspapers/TH18630207.2.21
[6] New Zealand Herald, Volume III, Issue 872, 30 August 1866, Page 4. Accessed online from: https://paperspast.natlib.govt.nz/newspapers/NZH18660830.2.15
[7] Otago Witness, Issue 1095, 23 November 1872, Page 10. Accessed online from: https://paperspast.natlib.govt.nz/newspapers/OW18721123.2.38
[8] Colonist, Volume XVI, Issue 1671, 23 September 1873, Page 2 (Supplement). Accessed online from: https://paperspast.natlib.govt.nz/newspapers/TC18730923.2.25
[9] Thames Advertiser, Volume IX, Issue 2354, 11 May 1876, Page 3. Accessed online from: https://paperspast.natlib.govt.nz/newspapers/THA18760511.2.10
[10] Otago Daily Times, Issue 5481, 12 September 1879, Page 7. Access online from: https://paperspast.natlib.govt.nz/newspapers/ODT18790912.2.60
[11] New Zealand Parliament, "One hundredth anniversary of 1907 fire at Parliament", 2007-12-11. Accessed online from: https://www.parliament.nz/en/get-involved/features/one-hundredth-anniversary-of-1907-fire-at-parliament

Figure 1. Parliament Buildings and Parliamentary Library fires Wellington – 1992
Photographer Derek Quinn, “Parliamentf.JPG” and “GALs.JPG” via www.111emergency.co.nz, 1992, Used with permission.

B.1.2 Residential homes

These fires have highlighted the challenges in more recent residential homes. This also includes some examples from overseas to highlight the challenges that have been faced in other countries.

HFE 9 – 2007 to 2014 – Residential fire deaths – New Zealand – FENZ commissioned research to identify the number of fatalities from unintentional fires in New Zealand and identify where were some of the circumstances that lead to these deaths[12].

The review found a total of 118 deaths in 107 unintentional fires across the 8 years. The number of fire deaths had declined in comparison to previous studies in the 1990s. The study found that older adults (over 65 years of age), males, and Māori had higher risk of death.

Other risk factors included those with disabilities, those who had consumed alcohol or drugs immediately before the fire, and those who were habitual smokers. These factors limit the ability of the occupants to exit the building and/or increase the risk of ignition of a fire. This research recommended that FENZ continue to support the use of smoke alarms and sprinkler systems in new and existing residential dwellings to reduce the number of fatalities.

HFE 10 – 2007 – MacEwan Fire – Edmonton, Alberta, Canada – The 21 July 2007 MacEwan fire was a large residential fire in Edmonton Alberta with over 100 homes damaged or destroyed[13]. This fire was one of many large-loss high intensity residential fires experienced in Alberta Canada starting in the early 2000s. Factors that lead to the fires related to the fire safety during construction, the spacing between the houses, the materials used on the outside of the houses, and the inability of firefighters to access and fight the fires. This resulted to changes in the Alberta and National Building Codes regarding:

- the construction of external walls and the exterior sheathing materials used close to boundaries;
- the construction of soffits, eaves, and balconies; and
- window spacing and dimensions close to boundaries.

HFE 11 – 2009 – Breaker Bay – Wellington – Figure 2 shows the aftermath of a house fire. All that remained after the fire was the structural frame with the rest of the walls and interior destroyed in the fire.

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[12] Lilley, R., & McNoe, B. (2018), “Unintentional domestic fire-related fatal injury in New Zealand 2007 – 2014, Fire and Emergency New Zealand Research Report Number 167, ISBN 978-1-92-728727-9. Accessed online from: Report-167-Unintentional-domestic-fire-related-injury-in-New-Zealand.pdf (fireandemergency.nz)

[13] Government of Alberta, “High-Intensity Residential Fires Working Group Final Report”, 2007-10-31, accessed online from: https://open.alberta.ca/publications/high-intensity-residential-fires-working-group-final-report

Figure 2. Breaker Bay Wellington – 7 June 2009
Photographer Peter Ashley, "BreakerBaym.JPG", via www.111emergency.co.nz, 2009, Used with permission.

HFE 12 – 2011 – Slack Creek – Brisbane, Queensland, Australia – A house fire resulted in the deaths of 11 people including 8 children. The smoke alarm in the house was deactivated[14]. It was believed that the fire started on the downstairs. It quickly spread through the building. This fire highlights the importance of smoke alarms in residential buildings.

HFE 13 – 2011 – FENZ Heads up article 11 Timber framed Chimneys – The Heads up article reported on chimney chases involved in fires where there was timber framing near the chimney. The timber was subjected to prolonged heating during operation of the fireplace creating a condition where the ignition temperature of the timber is reduced to well below usual ignition temperatures. Eventually, this can cause a fire. Resulting fires may enter the roof space or drop down through the chimney chase into the home.

HFE 14 – 2013 to 2023 – Fire spread – New Zealand – FENZ provided information on fire spread in buildings fire between 2013 to 2023. This data shows that the number of fire instances responded to has not significantly increased in the past 10 years. However, the number of fires that have spread beyond the building of origin has increased over 150%. There are many reasons why this could occur including inadequate spacing between buildings, inadequate firefighting access, or inadequate water supplies.

HFE 15 – 2013 – Mount Cook Wellington – A photo of this fire is in Figure 3. This photo shows flames coming out of and extending up to a meter from the house.

The distance between the houses is several meters and sufficient to limit fire spread between the houses at this stage in the fire. As a fire develops, it can be expected that flames will get larger with more heat received by the adjacent houses.

[14] The Guardian (2014-08-14), "Logan house fire in which 11 died: 'noisy' smoke alarm was switched off", Accessed online from: https://www.theguardian.com/world/2014/aug/18/logan-house-fire-in-which-11-died-noisy-smoke-alarm-was-switched-off

The photo also shows some of the challenges for firefighting when a house is distant from the street. The firefighters had to run hoses up the hill in front of the street in order to fight the fire taking time and effort to complete this task.

Figure 3. A photograph of the fire in Mount Cook Wellington on 25 Apr 2013.
Source: "Rolleston-12.JPG" via www.111emergency.co.nz, 2013, Used with permission.

HFE 16 – 2015 – FENZ Heads up article 20 Incomplete fire separations – The fire service reported on a house fire where fire spread through eaves across a boundary and resulted in damage to multiple residential units and significant damage to the building. This highlighted issues in the construction of soffits and that incomplete junctions of fire separations can result in gaps in protection that allows a fire to by-pass other fire resisting elements.

HFE 17 – 2016 – FENZ Heads up article 25 Fire separation in domestic houses – A fire occurred on the 20 July 2016 in a residential house which had been separated into two tenancies. Both tenancies had working smoke alarms.

The fire started as an electrical fault in a ceiling mounted extraction fan in the bathroom and quickly spread throughout the ceiling void of the occupancy breaking into the main unit and causing widespread destruction in that tenancy.

When the fire reached the internal wall separating the 2 tenancies, the fire separation prevented fire spread into the adjoining unit and enabled the safe escape of the occupant and the extinguishment of the fire in the main unit. The adjoining unit remained almost totally undamaged. Inspection of the ceiling void above the main house revealed an intact fire separation which extended from the walls below terminating at the roof junction. This house fire example highlights how effective a well-constructed fire separation can be in containing a fire.

HFE 18 – 2019 – FENZ Heads up article 28 Fire spread from garden shed – A fire occurred in a shed on a residential property. The shed was located between a house on the same property and a wooden fence on the property boundary. The fire spread to the adjacent fence, spread to the house on the same property, and spread to the neighbouring house before firefighters were able to extinguish it. An investigation of the fire found that the shed had been located too close to both the residential house on the same property and the property boundary.

HFE 19 – 2019 – FENZ Heads up article 29 Fire from reflective surface – Concentrated radiated heat from reflected sunlight ignited timber cladding and caused damage to the upper level and roof of a house. A combination of concentrated sunlight, lack of cooling due to still wind conditions and a black painted timber board absorbing the heat coincided leading to ignition conditions.

HFE 20 – 2019 – House explosion – Christchurch – On 19 July, a gas explosion destroyed a house in Christchurch and damaged 5 other properties. The explosion occurred after a gasfitter failed to isolate the gas supply during repair work and gas filled the house overnight. The gas was ignited by an electric thermostat on the hot water cylinder[15]. Two people were severely injured.

HFE 21 – 2022 – Mixed residential housing – On 7 April, a fire occurred in a mixed residential housing zone in a building site with residential infill housing. The fire started at 5 am and fire crews arrived with 7 minutes of being notified. The last fire appliance did not leave the scene until after 1 pm.

The fire was attended by 15 different appliances. One firefighter was injured with minor burns. The fire destroyed the property and 3 other surrounding properties.

This fire was challenging for firefighters because of the lack of firetruck access to the development. The driveway was 45 m long and 2.9 m wide and too narrow to fit a fire truck through. Access to the house involved firefighters marching on foot and breaking down a fence on a neighbouring property. The street hydrant for firefighting was also over 270 m away. This meant that firefighters had to lay hoses equal to the length of more than two rugby fields.

The building complied with Acceptable Solution C/AS1 requiring a minimum of 2 m separation for buildings on different properties. But, the amount of heat radiated to the adjacent building was estimated to be approximately 3 times higher than permitted by the code clause C3.6.

At this fire:

- 50 firefighters put their personal safety at risk to put out the fire
- 4 families were out of home leading to additional stress with financial costs
- there was over 20 tonnes of debris left to be cleaned up
- over 180,000 L of water was used to put out the fire, and
- 30-40 tonnes of CO_2 equivalent gas was emitted by the fire.

HFE 22 – 2024 – Townhouse e-scooter fire – Christchurch – On 10 February, a fire started when the battery of an e-scooter charging on the ground floor of a townhouse went into thermal runaway (where the battery enters an uncontrollable, self-heating state). The rapid fire development meant that a mother and her child were unable to escape initially, and the mother passed her child down to someone outside from the second floor of the building[16].

The fire did not spread to adjacent townhouse units. There have been other instances of e-scooter fires in Wellington[17] and Auckland[18].

[15] Stuff (2020), "Cause revealed of gas explosion that destroyed Christchurch house". Accessed online from: https://www.stuff.co.nz/the-press/news/300182211/cause-revealed-of-gas-explosion-that-destroyed-christchurch-house
[16] Star News (2024-02-28), "Child caught after escaping fire in top floor apartment". Accessed online from: https://www.odt.co.nz/star-news/star-christchurch/child-caught-after-escaping-fire-top-floor-apartment
[17] The New Zealand Herald (2023-07-31), "E-scooter explosion: Victim critical days after unstoppable battery fire". Accessed online from: https://www.nzherald.co.nz/nz/e-scooter-explosion-victim-critical-days-after-unstoppable-battery-fire/6SH4RDFQBFDBPP5YSZR6NIST5A/
[18] The New Zealand Herald (2024-08-22), "Electric scooter sparks fire at Auckland apartments, 200 residents evacuated". Accessed online from: https://www.nzherald.co.nz/nz/smoke-billows-from-auckland-apartments-residents-evacuated/37C2XW2O2JAEFK5NACI4CUIZ4Q/

B.1.3 Transient accommodation including hotels, motels, boarding houses, and similar

This section contains some significant fire events from the past 80 years. There are many examples that had similar circumstances or outcomes as the fire in the Loafer's Lodge boarding house in Wellington.

HFE 23 – 1946 – Winecoff Hotel Fire – Atlanta, Georgia, United States – The Winecoff Hotel fire killed 119 people and remains the deadliest hotel fire in U.S. history.

There were 304 guests and 119 died and 65 were injured. The deaths included 32 people who jumped or fell trying to climb down make-shift bedsheet ropes.

The building had a single stairway with no fire doors to protect the stairs. This resulted in the fire spreading to multiple levels of the building. The non-combustible building structure of the building was advertised as "absolutely fireproof" but had combustible linings including walls in corridors and hotel rooms. This fire highlighted the importance of fire doors in hotels.

HFE 24 – 1966 – Williams Booth Memorial Home – Melbourne, Australia – This was the deadliest fire in Australian history and 30 people died. The building served as a hostel for the Salvation army. The people in the building lived in iron mesh cubicles like cages inside the building. The fire started on the third floor of the 5-storey building. This fire highlights the challenges with fire safety in shared accommodation buildings when escape is difficult.

HFE 25 – 1975 – Savoy Hotel Fire – Sydney, Australia – This fire resulted in the death of 15 guests in the hotel with injuries to 25 more. The fire was an arson fire started on the ground floor in a stack of newspapers. The smoke spread up 2 stairs cases and trapped 60 people in the floors above. This fire highlighted the importance of protected stairwells and the hazards of smoke movement in a building.

HFE 26 – 1981 – Rembrandt Hotel Fire – Sydney, Australia – Eight people died in this 4-storey residential hotel. The hotel had a single stairway which was filled with smoke. Residents from the upper levels jumped from windows and ledges[19].

HFE 27 – 1980 – MGM Grand Hotel Fire – Las Vegas, Nevada, United States – This fire in the 26-storey hotel resulted in the deaths of 85 people. The fire originated on the first floor and smoke travelled throughout the hotel.

The building was not protected with sprinklers. The evacuation of the building was also hard as the lifts in the building did not return to the ground floor resulting the deaths of 10 people trapped in the lifts.

Firefighting was also hindered as exterior ladders could only reach the ninth floor. Most of the deaths in this fire were due to toxic fumes and smoke caused by the poor ventilation system.

This fire highlighted the hazard of smoke and toxic gases during a fire and smoke movement through the building. Following another fire in the Las Vegas Hilton 3 months later, the Nevada building codes were revised to require fire sprinklers and smoke detectors in public buildings.

HFE 28 – 1987 to 2007 – New Zealand – Between 1987 and 2007 there were 27 fire fatalities in transient accommodation buildings in New Zealand[20]. In 1992, 7 people died in a fire at Ferry Road Hostel.

[19] UPI Archives (1981-08-25), "Eight die in fire, some dive out windows". Accessed online from: https://www.upi.com/Archives/1981/08/25/Eight-die-in-fire-some-dive-out-windows/7370367560000/

[20] Thomas, G. Harding, D. (2014), "Fire safety in New Zealand transient accommodation buildings", Building a Better New Zealand. Accessed online from: https://www.researchgate.net/publication/273123751_FIRE_SAFETY_IN_NEW_ZEALAND_TRANSIENT_ACCOMMODATION_BUILDINGS

Appendix B. Lessons learned from the past

In 1995, 6 people died in the New Empire Hotel Fire. Fatal fires were more likely to occur in cheaper accommodation, and in older buildings constructed prior to 1970. These buildings were often without smoke detection or fire alarm systems and were unlikely to be sprinklered.

It was estimated that there was 11 times greater risk of a fatality in transient accommodation in New Zealand than in other types of residential buildings. This is similar to the United States experience with several severe boarding home fires occurring between 1979 to 1984. The risk of dying in a multiple death boarding homes fire in the US was estimated as five times greater than in other residential buildings.

HFE 29 – 1989 – Downunder Hostel Fire – Sydney, Australia – A fire in the 3-storey hostel spread quickly through the single stairwell in the building resulting in multiple deaths in the building. Following this fire, the coroner provided recommendations for the number of exits, use of sprinklers systems, and other fire safety features[21].

HFE 30 – 1991 – Palm Grove Hostel – Dungog, New South Wales, Australia – A fire in this hostel resulted in the deaths of 12 people with injuries to 28 more. It took firefighters 4 hours to control the fire and the building was destroyed.

HFE 31 – 2000 – Childers Palace Backpackers Hostel – Childers, Queensland, Australia – The arson fire in this hostel resulted in the deaths of 15 backpackers. The fire started on the first floor and spread into the stairwell.

The building lost power. Alarms and lighting did not work. Ten people were injured as they tried to jump from the upper level of the hostel. One room where 10 people died had a blocked exit door and barred windows. Following the fire, the Queensland Government passed fire safety legislation to increase the minimum requirements for fire safety for accommodation buildings including the use of sprinklers.

HFE 32 – 2004 – FENZ Heads up article 1 Accommodation Block – Auckland – A fire started in the kitchen of an apartment on the tenth floor of a 17-storey single stairwell apartment building. The occupants of the apartment were notified when a sprinkler activated the fire alarm system. A smoke detector did not activate until the occupants opened the door to the bedroom they were in. Firefighters had difficulty reaching the floor of fire origin due to the number of people coming down the stairs.

The sprinkler system effectively extinguished the fire. Some of the smoke detectors had plastic protective covers on them to prevent unwanted false alarms – these would also delay detection of a real fire event. This included a smoke detector in another bedroom in the apartment of fire origin.

The stairwell was also meant to be pressurised in the case of fire, but the pressurisation system did not activate in the event. Firefighters could not locate the floor isolation valve so had to isolate the entire sprinkler system, adding to the life risk immediately after the fire.

HFE 33 – 2010 – FENZ Heads up article 6 Office to Apartment Conversion Declared Dangerous – A residential apartment building had a number of defects identified within it which led to it being declared dangerous.

Originally built as an office block, this six-level building had been converted into apartments. When it was converted, a conventional smoke detection system was installed over the existing system which meant that activation of a smoke detector initiated a building wide evacuation.

A subsequent inspection of the system concluded that:

- because of the way the installation had been done it only met the requirements of a Type 3 system which activates on heat detection instead of smoke.
- the system had not been connected to notify the fire service
- a building hydrant system (riser main) been installed.

[21] Sydney Morning Herald (1990-05-05), "Tough new fire rules for hostels".

These were requirements of the building consent. A number of other issues were discovered including unsealed penetrations in fire separations and non-functional fire doors.

HFE 34 – 2011 – FENZ Heads up article 5 Fire in Multi Story Apartment Block – This incident was in an up-market apartment building, with eleven residential levels and four basement car park levels. The building was sprinkler protected and fitted with manual call points and smoke detection throughout except for the car park firecells.

The fire is believed to have originated from a domestic dispute between a resident and a guest. Following the dispute, one of the parties descended to the basement car park, removed a foam mattress from a storage locker, and set it alight under the stair at the lowest level.

The fire activated the stairway smoke detection, which initiated a building wide evacuation. The building had an onsite manager who proceeded to investigate the cause of the alarm activation. Upon opening the stairway door, the manager described the smoke in the stairway as being brown in colour, with a toxic odour. He estimated visibility within the stairway to be no more than 1.5 metres. The sprinklers did not activate because the coverage area did not extend to the underside of the concrete stairs.

HFE 35 – 2016 – FENZ Heads up article 24 Unlawful conversions to residential accommodation – Two separate fires (December 2015 and January 2016) were in buildings which were consented as commercial premises but had been unlawfully converted to accommodate residential occupants.

The first fire occurred in a car mechanical workshop which had sleeping accommodation on the upper level. There was no automatic fire alarm system provided.

The second incident involved a building that had multiple alterations and extensions over time. But none of the consented works included converting it for residential use. The Territorial Authority had issued several notices to the building owner, including two Dangerous Building Notices but remediation work had not been completed at the time of the fire.

HFE 36 – 2016 – Hotel Kitchen fire – Wellington – On 3 December, a fire occurred in the kitchen of a newly open hotel. Some of the active and passive fire protection systems failed to operate resulting in widespread damage to the building[22]. The hotel was closed for at least 7 months while the damage was repaired.

This fire highlights the challenges when single components in the fire safety systems do not operate as expected. It also highlights the impact that fire and smoke damage can have on the operation of a business.

HFE 37 – 2019 – FENZ Heads up article 27 Fire protection systems – This article discussed 3 different fires in residential buildings where smoke alarms and sprinklers systems were effective.

In the first incident, a fire occurred at 4:30 am which activated the smoke alarms. While the house was destroyed, all members of the family were saved.

In the second incident, sprinklers activated in a 4-level hostel which had a fire in a single bed. A door to the hallway was partially jammed open and fire had already started to spread to the hallway before the sprinkler activated.

In the third incident, a small fire occurred in a hot water heater on the upper floor of a high-rise apartment building. The apartment was filled with smoke but the small fire failed to activate sprinklers. Smoke detectors in the apartment providing early warning to building occupants enabling their safe evacuation and transmitted an alarm to the fire service who responded.

[22] John Lucas (2018), "Passive fire compliance seminar a hot event", Industrial Safety News Magazine. Accessed online from: https://www.safetynews.co.nz/passive-fire-compliance-seminar-hot-event/

HFE 38 – 2019 – Wembley Private Hotel – Auckland – The fire in the 3-storey building resulted in the death of one of the occupants. The building was equipped with smoke alarms which notified the fire service. These features likely prevented an even worse outcome of the fire.

HFE 39 – 2023 – Loafers Lodge – Wellington – A fire in the upper level of the Loafers Lodge boarding house resulted in the deaths of 5 people and 5 injured[23]. The 5-storey building was originally constructed as a warehouse 50 years ago. The building had undergone multiple changes in use since that time and was not protected with sprinklers. Investigations into the fire are still ongoing.

HFE 40 – 2023 – Operation Magazine[24] – New Zealand – Following the tragedy at Loafers Lodge, MBIE inspected similar properties throughout New Zealand to assess the level of fire safety in boarding houses (known as Operation magazine). Almost all buildings inspected had at least one general fire safety systems issue, but many had more issues, including:

- inadequate fire and smoke separations (including fire and smoke stop doors) – this was the most common issue found,
- obstructed or inadequate escape routes,
- missing, misleading or illegible exit signs to help evacuations in the case of a fire,
- issues with fire alarm systems, for example parts of the system (smoke detectors) were missing or provided inadequate coverage of the building or were unmonitored by the fire service or compromised in some way.

HFE 41 – 2023 – Derelict boarding house – Dunedin – A fire started in a derelict boarding house in Dunedin. People were initially unaccounted for as there were reports of people squatting in the building[25]. The fire spread to 2 adjacent properties and caused damage. This fire highlighted concerns about the fire safety of buildings near the end of their lives which may have compromised fire safety systems.

Fires in buildings that are no longer actively managed can still threaten adjacent property, damage the environment and are still a risk to firefighters.

B.1.4 Hospital and care facilities

These fires represent significant events in hospitals and care facilities that have resulted in changes to the requirements in these facilities.

HFE 42 – 1942 – Seacliff Mental Hospital Fire – Dunedin, New Zealand – A fire in one of the wards resulted in the deaths of 37 out of 39 patients. It was standard procedure to keep the patients in the locked ward without supervision. The two-storey wooden building was reduced to ashes in the fire. The resulting inquiry into the fire recommended that care facilities be constructed of fire-resistant materials, be provided with emergency exits, and be protected with fire alarms and sprinkler systems[26].

HFE 43 – 1961 – Hartford Hospital Fire – Connecticut, United States – This fire started in a trash chute and spread to the ninth floor. The fire ignited combustible linings in the hospital which consisted of combustible tiles glued overtop of plasterboard.

The combination of the tiles and the glue resulted in rapid fire spread. Adding to this, firefighters were hampered in their efforts to reach the floor and ladders from the outside did not reach the ninth floor.

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[23] Stuff (2023-05-20), "The full story of the Loafers Lodge blaze". Accessed online from: https://www.stuff.co.nz/national/132086649/the-full-story-of-the-loafers-lodge-blaze

[24] More information about Operation Magazine can be found on building.govt.nz at https://www.building.govt.nz/managing-buildings/report-into-safety-assessments-of-boarding-houses

[25] The New Zealand Herald (2023-10-27), "Dunedin boarding house fire: People unaccounted for", Accessed from: https://www.nzherald.co.nz/nz/dunedin-boarding-house-fire-people-unaccounted-for/AZ3NIXOWMZCQ7LFWVNMECF6WKY/

[26] "Deadly fire at Seacliff Mental Hospital". Accessed from: https://nzhistory.govt.nz/fire-seacliff-mental-hospital-kills-37

One firefighter reportedly jumped from the ladder to an open window to help assist occupants. 16 people died during the fire including hospital staff and patients. This prompted code changes in the United States to limit combustible linings in hospitals and protect these buildings with sprinklers.

HFE 44 – 1969 – Sprott fire – Wellington – A fire in this rest home resulted in the death of 7 elderly women. It lead to increased fire safety measures such as sprinklers and fire alarms in rest homes and hospitals[27].

HFE 45 – 1996 – Kew Cottages – Melbourne, Victoria, Australia – This building housed people with intellectual disabilities. The building lacked sprinklers and adequate fire alarm system. Residents were left in a locked ward during the night. The fire resulted in the deaths of 9 people.

HFE 46 – 2006 – FENZ Heads up article 2 Rest Home – Auckland – A fire started in a lounge area between 2 sleeping areas in a sprinklered rest home complex of interconnected 1- and 2- storey buildings.

The fire alarm system notified the staff of the fire. Staff were delayed in locating the fire as they had difficulty reading the fire alarm panel index. A nurse was faced with heavy smoke when they opened double doors into the lounge. Firefighters became blocked by a door locked by a combination lock. While the combination was posted above the door, the firefighters could not see it at the time due to smoke. The roof shape affected the ability of water from the activated sprinkler to reach the fire.

HFE 47 – 2011 – Quakers Hill Nursing Home – Sydney, New South Wales, Australia – Two fires were deliberately set in separate wings of the building in the early morning of 18 November[28]. Over 100 firefighters and 25 fire trucks responded to evacuate the residents.

Firefighters had difficulty responding due to the:

- confusion over the two fire sources
- thick smoke in the wards, and
- collapse of the ceiling in the building.

Many of the residents had to be carried from their beds by firefighters. Twenty-one residents died in the fire.

Following this fire, the New South Wales Government made installation of sprinkler systems mandatory for all existing nursing homes.

HFE 48 – 2014 – L'Isle-Verte Nursing Home fire – Quebec, Canada – This fire in a retirement home resulted in the death of 32 elderly people with 15 more injured.

The fire was likely caused by a discarded cigarette. The wooden building was partially protected with sprinklers with a firewall separating the sprinklered annex and the unsprinklered main building.

The unsprinklered portion of the building burnt to the ground. Firefighters on the scene reported hearing people on balconies yelling "Save us, save us"[29]. Similar to the Quakers Hill Nursing Home fire in Australia, this fire prompted a review across Canada into the fire safety provisions in existing retirement villages and long-term care facilities. Legislative changes now require existing buildings to be upgraded to be protected with sprinklers[30].

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[27] Nancy Swarbrick (2010), "Fires and fire services - Towards a national fire service", Te Ara - the Encyclopedia of New Zealand. Accessed online from: http://www.TeAra.govt.nz/en/photograph/21877/sprott-house-fire

[28] Fire and Rescue New South Wales (2024), "Lessons from the Quakers Hill Nursing Home Fire". Accessed online from: https://www.fire.nsw.gov.au/page.php?id=9134

[29] CBC News (2014), "Firefighters recall L'Isle-Verte residents' desperate cries for help". Accessed from: https://www.cbc.ca/news/canada/montreal/firefighters-recall-l-isle-verte-residents-desperate-cries-for-help-1.2849241

[30] CTV News (2013), "Mandatory sprinklers at retirement, long-term care homes among fire code changes. Accessed from: https://toronto.ctvnews.ca/mandatory-sprinklers-at-retirement-long-term-care-homes-among-fire-code-changes-1.1273718#:~:text=TORONTO%2C%20Ontario%20%2D%2D%20Ontario%20has,regulations%2C%20which%20take%20effect%20Jan

B.1.5 Crowd occupancies including retail, nightclubs, and educational facilities

This section contains a number of fires with high fatalities in crowd occupancies over the past 100 years as well as fires that have caused damage to the buildings.

HFE 49 – 1903 – Iroquois Theatre Fire – Chicago, Illinois, United States – The Iroquois Theatre fire occurred in the afternoon of 30 December 1903 in Chicago. The fire was fuelled by flammable fabrics and drapery used in the theatre.

Doors from the theatre were locked or hidden and audience members were unable to evacuate. The tragic event took the lives of 602 people and injured 250 others which was the deadliest fire event in the US until the collapse of the World Trade Centre.

This fire highlighted the needs for fire safety features for theatre stages (smoke curtains, smoke venting, and sprinklers) as well as the need for exit signs, emergency lighting, and escape routes in large crowds.

A similar fire, the Rhoades Opera House Fire in Boyertown, Pennsylvania 1908, also involved a stage fire and resulted in a high number of deaths.

HFE 50 – 1908 – Lakeview Grammar School Fire – Collinwood, Ohio, United States – There were multiple fires affecting schools in the US between 1900 and 1950 where more than 10 people died. The most significant events included the Lakeview Grammar School fire. On 4 March 1908, a fire broke out at Lakeview Grammar School in Collinwood, Ohio, resulting in the deaths of 176 people, mostly children. The school had inadequate escape routes and exit paths that bottlenecked, preventing many from escaping.

HFE 51 – 1942 – Cocoanut Grove Nightclub fire – Boston, Massachusetts, United States – The was a catastrophic event that claimed 492 lives of the 1000 occupants in the nightclub. Several factors contributed to the high death toll including severe overcrowding of the building, inadequate exits, and highly combustible decorations.

One of the most tragic aspects of the fire was that 200 people perished behind a single blocked revolving door unable to escape.

HFE 52 – 1947 – Ballantyne’s Fire – Christchurch, New Zealand – This was the deadliest fire in New Zealand’s history. Smoke from the basement cellar filled the building and prompted the evacuation of the ground floor of the building.

No call was made to evacuate people from the upper floor as the fire was not seen to be serious. Over the course of the next half hour, customers continued to enter the store and staff were instructed to go back to work.

When the seriousness of the fire was realised, it was already too late. Exit routes and fire escapes from the top level were eventually blocked by heat and smoke and 41 people died. Over 200 firefighters were brought in to fight the fire which burned for 5 hours.

HFE 53 – 1958 – Our Lady of the Angels School fire – Chicago, Illinois, United States – The fire was a tragic event that resulted in the deaths of 95 people, including 92 children and 3 nuns.

The building had a single exit, no fire detection system, no sprinklers, and limited fire-resistant construction. Smoke spread up the stairwell and into the second floor, trapping people on this level.

Following the fire, the US codes were updated to include stricter requirements for interior finishes and exit lights in schools. Since this fire and the changes to the Codes, the US has not experienced another school fire killing 10 or more people.

HFE 54 – 1973 – Whiskey Au Go Go – Brisbane, Queensland, Australia – In the early morning, an arsonist started a fire in the foyer of this building. The club had approximately 50 people inside and the only escape route was through rear stairs.

Smoke spread from the foyer into the first floor. Patrons had difficulties exiting the building and many jumped from broken windows down to the ground floor. Fifteen people died in the fire due to carbon monoxide poisoning.

HFE 55 – 1985 – Bradford City stadium fire – West Yorkshire, England – During the final match of the season, a fire broke out amongst the stadium seating. Within 4 minutes, the fire had spread across the stands and trapped people in their seats. Some spectators were unable to escape due to locked exits and turnstiles. 56 people died and 265 were injured.

The fire resulted in changes to UK stadiums with a ban on wooden grandstands.

HFE 56 – 1987 – King's Cross fire – London, England – A fire in the tube station resulted in the deaths of 31 people and injuries to 100 more. The fire began in a wooden escalator which eventually lead to flashover and intense heat and smoke killing those in the ticket hall.

Several hundred people were then also trapped below. The investigation into the fire lead to better understanding of fire spread behaviour on inclined surfaces (known as the trench effect) along with changes to subway station regulations[31].

HFE 57 – 2003 – E2 nightclub stampede – Chicago, Illinois, United States – 21 people died after pepper spray was used inside the venue resulting in a panicked evacuation of the building.

The victims were crushed as 1500 people tried to flee the building. The building had a number of issues with its escape paths and exits including narrow doors, doors opening in the wrong direction, and blocked exits. This event highlights the importance of evacuation features for emergencies other than fire.

HFE 58 – 2003 – Station Nightclub – Rhode Island, United States – This fire occurred in a small music venue where pyrotechnics on the stage ignited the flammable polyurethane soundproofing insulation on the walls and ceiling.

The fire developed quickly with flashover (the room fully involved in fire) observed in 90 seconds. The building was not protected with sprinklers. 100 people died in the fire with many trapped or unable to exit the building. The fire is also notable as a cameraman was inside the venue filming a new story and captured the development of the fire and resulting carnage.

This fire highlighted the dangers of surface finish linings and resulted in changes to codes in the United States requiring sprinklers in nightclubs meant for over 150 people.

HFE 59 – 2007 – FENZ Heads up 4 Shopping Mall – Auckland – A shopping mall was filled with smoke one afternoon after a fire broke out in the storeroom of one of the tenancies.

During a post incident audit into the event some issues were found with the smoke control and suppression systems.

The tenancies were to be fire rated from one another, but this did not appear to be the case and the separations had not been properly maintained, and showed defects.

[31] Fennell, D., Investigation into the King's Cross Underground Fire, Her Majesty's Stationary Office, London, UK, November 1988.

The sprinkler system was not effective, possibly due to heads incorrectly placed or more likely alterations to the building had taken place after sprinkler installations, leaving some areas without coverage.

These deficiencies had not been picked up during sprinkler system checks.

The smoke control system did not operate as it was designed and could not effectively control smoke spread. It is unclear what actually caused the system to stop working.

HFE 60 – 2011 – FENZ Heads up article 10 Change of use, fire and smoke spread – Auckland – A deliberately lit fire in a retail business caused a multi-million loss to other tenancies in the building including extensive damage to health monitoring and screening equipment in a medical centre.

It appeared that the building was built as 2 separate firecells (ground and first floor levels) and divided into tenancies with light non-fire rated internal walls.

There was no separation between tenancies in the ceiling space and smoke was able to travel freely from one to the other.

The building was consented in 1986 but its use was not in-line with what it had been consented for. Had the change of use been handled correctly, it is possible that the fire safety systems would have been upgraded to prevent the damage to the other tenancies.

HFE 61 – 2014 – FENZ Heads up article 19 Fire Protection in Large Spaces – A fire occurred in an arena which was 9000 m^2 in size with an internal height of 26 m.

The arena has a sprinkler system, with smoke detection in the air handling ducts. The arena had been fitted out to accommodate a home show which consisted of 200 stands of retailers.

The arena had been shut and all power switched off, except 2 fridges and the spa pool stand.

At 6 in the morning, the fire service received a call that the sprinklers had activated. Upon arrival, they found smoke in the building and the sprinklers had activated above the spa pool stand. The stand acted as a shield and prevented the sprinklers from suppressing the fire. The fire was contained to 3 spa pools and the sprinklers stopped the fire from spreading further.

Due to the extensive smoke spread in the building, the organisers had to cancel the show. This event highlights the challenges with large spaces and high ceilings. They add a considerable amount of time before sprinklers activate and more suitable methods of detection may be needed.

It highlights the usefulness of sprinklers controlling the spread in rooms even when a fire is shielded directly from the sprinkler spray.

HFE 62 – 2014 – FENZ Heads up article 21 Fire alarm monitoring – This article outlined several fire instances where there were delays in notifying the fire service, this included 2 schools and 2 warehouses.

The damage to the buildings was extensive and in some cases resulted in a total loss of the building.

These instances highlighted the importance of notifying the fire service in a timely manner. For 2 of these incidents, the fire service was notified by members of the public.

In the other 2 examples, critical information available to the monitoring centre was not passed on to the firefighters. These factors cancelled out the possible benefits of early detection of a developing fire to help limit the fire spread and damage.

HFE 63 – 2016 – Ghost Ship Warehouse fire[32] – Oakland, California, United States – This fire started in a derelict warehouse building which was being used for living spaces. The fire started during a concert event in the building which had approximately 100 attendees. The building was not legally permitted for these uses.

The fire spread across the ceiling and generated significant smoke. The building contained a very high fuel load with furniture in the living spaces. There were no fire alarms, smoke alarms, or sprinklers in the building.

Stairwells were makeshift construction from pallets and impeded exiting from the building. The 'maze-like' nature of the building and living spaces made it difficult for firefighters to respond. 36 people died in the fire.

B.1.6 Low-rise office and industrial buildings

These fires are more recent fires where firefighters were put in harm's way or there was damage to the buildings.

HFE 64 – 1999 – Worchester Cold Storage Fire – Massachusetts, United States – A fire was started in a derelict, 6-storey cold storage building, reportedly by 2 homeless people squatting in the building who had knocked over a candle.

The building had no windows above the first floor. The fire burned undetected for up to 1.5 hours as there were no active fire safety systems in the building that could detect the fire and transmit a signal to alert the fire service.

The layout of the building was challenging for firefighters who were not familiar with it. Six firefighters could not escape the building and died in the fire. This fire highlights the risks posed to firefighters when buildings are no longer actively maintained.

HFE 65 – 2005 – Cashel Chambers – Christchurch – Photos of this fire show some of the challenges in firefighting in urban environments where buildings are close together (see Figure 4). The fire started on the third floor of the building and quickly spread throughout the half-block. The building was vacant at the time and the fire was primarily fought from the outside. Access for firefighting could only be obtained from one side of the building.

Figure 4. Cashel Chambers building in Christchurch – 23 January 2005 showing the fire and showing fallen debris on the road

Sources: Left hand side: "CashelAnon5.JPG", via www.111emergency.co.nz, 2005, Used with permission. Right hand side: Photographer David Miller, "Cashelk.JPG", via www.111emergency.co.nz, 2005, Used with permission.

[32] The New York Times, "Oakland 'Ghost Ship' Fire", Accessed online from: https://www.nytimes.com/news-event/oakland-ghost-ship-fire

HFE 66 – 2006 – Shed Fire – Blenheim – Figure 5 shows firefighters responding to a fire in a shed. Sheds fall within the classification for outbuildings in the Building Code.

Outbuildings are not required to have access for firefighting in the Building Code and have limited requirements for work to put them out where safe to do so. Fires in outbuildings have the potential to spread to other surrounding structures, vegetation, or lead to substantial loss of property.

Figure 5. Shed Fire Blenheim – 23 September 2006
Photographer Craig Love, "Redwoodtownc.JPG", via www.111emergency.co.nz, 2006, Used with permission.

HFE 67 – 2007 – Triple M Housing Fire – Alberta Canada – A fire started at the rear of a mobile home manufacturer's facility[33]. The timber building was an adapted aircraft hangar. A strong wind drove the fire from the rear of the facility to the front.

The fire resulted in the complete loss of the building and over 10 vehicles parked at the front of the building.

A fire truck parked at the front of the building pumping water to fight the fire was also lost.

This fire highlighted the hazards created from rapid fire spread through a large industrial facility with a high fuel load as well as the hazard when fire trucks and firefighting attendance points are too close to unprotected buildings.

HFE 68 – 2008 – Timber factory – Blenheim – Figure 6 shows a fire at timber factory. 30 firefighters and 7 appliances were called to respond to the fire. There were concerns that the chemicals stored on site may pose an environmental hazard.

[33] https://canada.constructconnect.com/joc/news/others/2007/10/massive-blaze-destroys-factory-of-pre-manufactured-home-builder-triple-m-joc024926w

Figure 6. Timber factory fire Blenheim – 14 January 2008
Photographer Anthony Sampson, "Flight-09.JPG", via www.111emergency.co.nz, 2008, Used with permission.

HFE 69 – 2008 – Tamahere Coolstore – Waikato – In the afternoon of 5 April, firefighters responded to an alarm activation at a coolstore building. There were no immediate signs of fire but a propane refrigerant leak ignited and engulfed the buildings.

The fire and explosion injured 8 firefighters and one of these firefighters later died in hospital.

There was no indication or warning that the building contained flammable refrigerants. The building was later described as a "bomb waiting to explode"[34]. This fire illustrates the risks presented by hazardous substances and the other types of emergencies firefighters respond to.

HFE 70 – 2011 – FENZ Heads up 9 Natural Ventilation Systems – This Heads up article from the fire service discussed 2 case studies where plastic skylights designed to melt in a fire to allows smoke to escape had failed to operate effectively. This led to significant build-up of heat and smoke in the building. Firefighters were required to access roof areas and use to tools to forcibly create openings in the roof.

HFE 71 – 2011 – Tofu factory – Auckland – A fire on the roof of the building on 12 May eventually lead to partial collapse of the roof.

The building was used as a coldstore previously and polystyrene insulation in the building generated a large volume of smoke.

Over 80 firefighters and 25 fire trucks attended the fire. Nearby businesses reported requiring staff to wear masks due to noxious smelling smoke entering their business[35]. The building was unsprinklered and was a completely lost. This fire highlights:

- the impact different materials can have on the production of toxic smoke from a fire, and
- the risk of collapse when a building is not protected with sprinklers.

HFE 72 – 2011 – Office building – Christchurch – On 18 May, a fire in an unsprinklered two storey office building led to a stair that three firefighters fell down and suffered injuries[36].

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[34] Stuff (2018-03-31), "Deadly Tamahere coolstore blaze: Remembering a day no one can forget". Accessed online from: https://www.stuff.co.nz/business/industries/102402172/tamahere-coolstore-fire-remembering-a-day-no-one-can-forget
[35] Otago Daily Times (2011-05-1), "South Auckland factory fire under control", Accessed online from: https://www.odt.co.nz/news/national/south-auckland-factory-fire-under-control
[36] Otago Daily Times, (2011), "Firefighters injured after floor collapses during blaze", Accessed online from: https://www.odt.co.nz/news/national/firefighters-injured-after-floor-collapses-during-blaze

The stair had a timber railing and stair treads which had burned away when the firefighters encountered the stair in low visibility due to smoke. The steel-framed roof also partially collapsed. Both the smoke in the building and structural failure of the building created a high-risk to firefighter safety.

HFE 73 – 2012 – FENZ Heads up 14 Building Paper Underlay Warehouse Buildings – A deliberately lit fire was started against the external wall of a large warehouse which quickly spread to the internal surface linings of the building travelling up the wall and across the ceiling.

Flaming pieces of building paper began to drop down onto stock below starting multiple fires within the building.

The multiple fires grew quickly and had the potential to overwhelm the sprinkler system.

Once installed, it is hard to tell building lining papers that are fire retardant from those that are not. This is because there is no requirement for them to be marked or labelled.

HFE 74 – 2014 – FENZ Heads up 18 Building Design Structural Integrity in Fire – A fire in a self-storage site in Wellington led to the loss and damage to items stored in numerous individual storage lockers on the upper level of the building.

Despite intervention by the fire service, the building was subsequently demolished. The secured divisions of the storage spaces were non-fire rated. This, together with the absence of a sprinkler system meant that effective measures to stop the fire could not be taken.

Media reported that items of unique cultural and economic importance were lost in this fire. Additionally, the building was designed using a performance-based approach and stairwells inside the building had a reduced fire resistance rating.

Firefighters investigating the fire were not aware of the design. Had the fire been on a lower level, it could have trapped or injured firefighters.

This event highlights the importance of considering firefighter safety in a performance-based design.

HFE 75 – 2014 – FENZ Heads up 22 Maintenance of fire protection systems – A fire occurred on the second floor of a 5-storey administration building which forms part of a hospital.

The building was fitted with a Type 7 automatic sprinkler system with smoke detection and manual call points. The sprinkler service agent was conducting works on the sprinkler system at the time of the incident. To allow these works to be conducted the agent isolated the sprinkler system of the entire building for the duration of the works.

To prevent false alarms and brigade callouts, the sprinkler service agent also isolated the fire alarm system of the entire building. This was done because the original system had not been commissioned correctly and they wanted to avoid a call to the fire service. But during the repair works, a staff member discovered a fire.

Attempts by the staff to alert the fire service and building occupants to the fire were severely hindered because the manual call points and emergency telephones were all deactivated.

Serious consequences were avoided thanks to the actions of the deputy fire warden, who was able to initiate the evacuation of the building occupants. The fire service was notified by mobile phone.

The isolation of the fire alarm system also prevented the release of door hold-open devices allowing smoke to travel freely within the building. There was significant damage in the room where the fire started and the rest of the floor suffered extensive smoke damage.

HFE 76 – 2018 – Chair factory fire – Lower Hutt – A large fire in the building needed 70 firefighters and 15 fire appliances to manage a fire that destroyed a factory[37].

The building had an automatic fire detection system which notified the fire service of the fire. The building had been in use for a long time and at one stage had a sprinkler system but it had been decommissioned at the time of the fire.

The building contained asbestos which was dispersed by the fire and found in dust that settled on the surroundings[38]. This fire highlighted the hazards can be generated from a fire to the surrounding environment.

HFE 77 – 2019 – Roofing building – Upper Hutt – On 25 January, a fire broke out at single storey industrial building containing a roofing and firewood company.

Firefighters arrived to find building heavily involved in fire as well as a grass fire along a curb. The grass fire was caused by an ignited diesel fuel leak from a ruptured 1000 L diesel tank inside the building.

The building was well separated from other buildings but had a sizeable fuel load due to the firewood contents of the building. After the grass fire was put out, external firefighting operations were then conducted on the building including removing sections of metal cladding to allow firefighting hose streams into the building (see Figure 7).

A rural tanker responded to the incident due to water supply limitations. The grass fire prevented access to the nearest hydrant so for the initial water supply the next closest hydrant was used, which was 6 hose lengths away.

Figure 7. Roofing building – 25 January 2019
Photographer Mark Osborne, "SJRoofing-1.JPG", via www.111emergency.co.nz, 2006, Used with permission.

HFE 78 – 2019 – Commercial/Industrial Warehouse – Auckland – On 3 February, FENZ responded to a smoke alarm activation at a warehouse.

Initial searches outside and inside the building could not identify a fire. But the smoke layer in the warehouse was forming above their heads and dropped rapidly resulting in near zero visibility inside the building.

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[37] The New Zealand Herald (2018-07-27), "70 firefighters, 15 engines at large factory blaze in Lower Hutt", Accessed online from: https://www.nzherald.co.nz/nz/70-firefighters-15-engines-at-large-factory-blaze-in-lower-hutt/FJFYQWMWF76RTOF2LJZR7H2QTE/
[38] RNZ (2018-09-13), "Dust coating cars in a Lower Hutt suburb contains asbestos", Accessed online from: https://www.rnz.co.nz/news/national/366397/dust-coating-cars-in-a-lower-hutt-suburb-contains-asbestos

A rescue team was used to recover the firefighters inside. Firefighters continued to fight the fire from outside the building and 2 fire trucks were damaged by the heat.

This fire highlighted some of the difficulties in fighting fires in large buildings where finding the source of the fire can be challenging. It also highlighted the damage caused when sprinklers are not present in buildings.

HFE 79 – 2019 – Municipal Building – Whangarei – An electrical fire caused millions of dollars' worth of damage to the 100-year-old Old Town Hall Building Whangarei.

The fire started in a ceiling cavity, quickly spread through the second floor and into the roof, and destroyed the landmark clock tower (see Figure 8).

The building had fire alarms and extinguishers but was not protected with sprinklers. Repair work to the heritage building is expected to be completed in 2025 at a cost of $7 million.

Figure 8. Whangarei Municipal Building – 20 October 2019
Photographer Jaymin McGuire, "Whangarei.JPG", via www.111emergency.co.nz, 2019, Used with permission.

HFE 80 – 2022 – Warehouse fire – Hamilton – On 12 February, a fire occurred in a warehouse that resulted in heat injuries to 6 firefighters.

The warehouse was in the final stages of construction of a 2000 m^2 addition.

The warehouse had glass fibre reinforced plastic (GRP) translucent roof panels that are meant to melt out in a fire event and to provide ventilation.

Despite a severe fire exposure, many of these panels did not melt out.

There were structural integrity concerns for the cold pressed steel framed roof prior to the fire which led to scaffolding being set up to support the roof. Potential collapse of the roof presented a hazard to firefighters.

A photovoltaic (PV) solar system had been installed on the roof. The fire melted cables leading from the PV panels to isolation switches. This created a situation where, once the sun rose, the PV panels began generating electricity which could not be isolated without electricians accessing the roof. There was also a risk that the steel structure could be energised as the electrical insulation degraded.

HFE 81 – 2023 – Sawtooth building – Wellington – A fire started in a large derelict warehouse building scheduled for demolition.

While the building had a sprinkler system installed, the water main supplying it had been cut and had not been repaired. FENZ had to use sea water to suppress the fire[39]. This fire ishows the need for fire safety to be maintained even if it is empty or due for demolition.

HFE 82 – 2023 – 11 Randle Street – Surry Hills, Sydney, New South Wales, Australia – A fire in a vacant heritage factory resulted in partial structural collapse of the building. Surrounding buildings and the street had to be evacuated as bricks, concrete, and other debris fell from the building and the external wall fell over.

HFE 83 – 2024 – Chemical explosion – Melbourne, Victoria, Australia – On 10 July 2024, a large chemical explosion engulfed a factory in flames in Melbourne, Australia and spread toxic smoke for miles around, necessitating 'watch and alert' for residents and road blockages[40].

B.1.7 High-rise buildings

These historic fire events show some of the challenges in tall buildings fires. They include high-profile events such as the collapse of the World Trade Centre and the Grenfell Tower fire. The events show issues with many skyrises, but also the challenges when fires are on buildings as low as 6 storeys.

HFE 84 – 1911 – Triangle Shirtwaist Factory Fire – New York City, United States – The Triangle Shirtwaist Factory fire occurred on 25 March 1911 in New York City.

The fire broke out on the top 3 floors of a 10-story building, leading to the deaths of 146 workers, many of whom were young women. The factory's locked exits and narrow aisles trapped the workers, making escape impossible.

The fire was witnessed by tens of thousands of onlookers leading to widespread public interest in the fire. This fire was one of the notable fires that lead to development of the first code for building exits in the United States.

HFE 85 – 1968 – Ronan Point – Newham, East London, England – A gas explosion caused partial collapse of the building only 2 months after it opened. Four people died and 17 more were injured.

The fire resulted in a UK regulation requiring buildings to be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause. This regulation has been credited with the reason why the Grenfell tower remaining standing after the fire.

HFE 86 – 1990 to 2020 – External cladding fires – There are approximately 60 high-profile cladding fires that have occurred around the globe since 1990[41]. This includes high-profile fires such as the Lacrosse building in Melbourne, Australia in 2016 and the Grenfell Tower Fire in London, England in 2017 which are discussed separately.

These fires all involved fire spread on the exterior of the buildings. These fires have helped:

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[39] Wellington.Scoop (2023-08-29), "Water main was broken, sprinklers didn't work and Sawtooth Building burnt down", Accessed online from: https://wellington.scoop.co.nz/?p=154775

40 RNZ (2024-07-10), "Chemical explosion sparks large factory fire in Melbourne". Accessed online from: https://www.rnz.co.nz/news/world/521802/chemical-explosion-sparks-large-factory-fire-in-melbourne

[41] Bonner, Matthew; Rein, Guillermo (2020), "List of Facade Fires 1990 – 2020", doi:10.5281/zenodo.3743863

- advance our knowledge of the performance of cladding systems, and
- led to changes to requirements for cladding fire testing in the New Zealand Building Code acceptable solutions and verification methods in 2017 and 2020.

Missing from this list of external cladding fires are fires involving cladding systems in New Zealand, such as:

- the construction fire associated with cladding at the Te Papa museum in Wellington. The exterior cladding of the Te Papa museum comprised a thin aluminium-faced panel with a polyethylene core, mounted over extruded foam polystyrene insulation board and building paper. During construction, there was a fire on the exterior facade as a result of burning building paper.
- a fire at Auckland University's Maidment Theatre[42], and
- a fire at the Whitireia polytech building in Auckland[43].

HFE 87 – 1991 – One Meridian Plaza – Philadelphia, Pennsylvania, United States – The fire in this 38 storey high-rise burned for 19 hours before it was controlled.

The fire started on the 22nd floor. The building was built in 1972 under a 1949 code that did not contain additional provisions for high-rise buildings and did not require sprinkler protection.

The building was in the process of having sprinklers installed but only 7 floors had any protection at the time of the fire. Firefighters were hampered because of inadequate pressure in the building's internal hydrants.

The fire only stopped after it had spread up to the 30th floor which was the first floor to have sprinklers. 10 sprinklers extinguished the fire and prevented continued spread. But by this time, 3 firefighters died as they were unable to evacuate the building. The building sat vacant for 8 years after the fire and was eventually demolished.

HFE 88 – 2001 – Collapse of the World Trade Centre – New York City, United States – In the wake of the devastating 9/11 World Trade Center attack, the National Institute of Standards and Technology (NIST) was tasked with uncovering the details of the disaster. Their goal was not just to understand what went wrong, but to ensure that future buildings would be safer, stronger, and more resilient.

There were 43 reports on the disaster and 31 recommendations covering aspects of the evacuation, structural design, fire protection systems, and firefighting response[44.] The NIST investigation findings and recommendations were:

- Stairwell capacity and stair discharge door width should be adequate to accommodate counterflow due to emergency access by responders.
- Stairwells and escape routes were difficult to navigate because of several 'transfer hallways'. In addition, the concentration of stairwells in the core of the building meant that the impact of the planes rendered evacuation above the impact impossible. Had stairwells been more dispersed in the building, it is possible that more occupants above the floors of impact could have escape the buildings. NIST emphasized that stairwells and exits should be strategically placed to maximize safety and that their designs should be consistent and intuitive to help people find their way out quickly.
- Many of the building's occupants were unprepared for the physical demands of a full-building evacuation. NIST provided recommendations calling for a re-think of evacuation systems including communications systems and the use of protected lifts in evacuation.

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[42] New Zealand Herald (2013-04-03), "Firefighters battle blaze at Auckland University threatre", Accessed online from: https://www.nzherald.co.nz/nz/firefighters-battle-blaze-at-auckland-university-theatre/V7WXL46M2A5JIG72KXEYB6JYPA/

[43] New Zealand Herald (2017-11-20), "Fire closes Auckland's Queen St", Accessed online from: https://www.nzherald.co.nz/nz/fire-closes-aucklands-queen-st/M64OARULVTA2D3C4UOFJQHW6UI/

[44] NIST (2022), "World Trade Center Disaster Study Reports and Other Publications". Accessed online from: https://www.nist.gov/world-trade-center-investigation/publications-and-reports

- Tall buildings may need to consider evacuation for a wider range of potential emergencies including power outages, major earthquakes, cyclones without sufficient advanced warning, fires, explosions, and terrorist attacks. Building size, population, function, and iconic status should be taken into account in designing the egress system.
- The emergency response faced significant challenges such as restricted access and communication breakdowns.
- Many of the fire protection systems (including the sprinkler system) were rendered inoperable by the impact of the planes. NIST recommended that the fire-resistant design of tall buildings should be enhanced by requiring an objective that uncontrolled fires result in burnout without local or global collapse.

HFE 89 – 2005 – Dunedin – Figure 9 shows flames burning outside of the windows in a multi-level building. The fire started on the top storey of the brick building which had been converted from a warehouse to residential and commercial uses.

The flames outside the building were extensive and impacted the adjacent building up to 3 storeys above the fire floor.

The fire destroyed the building and several firefighters were treated for burns to their hands and faces. Other photos of the fire and similar instances in New Zealand can be found in BRANZ Study Report SR409[45].

Figure 9. Dunedin – 20 July 2005
Photographer Firefrog, "DunedinFirec.JPG", via www.111emergency.co.nz, 1992. Used with permission.

HFE 90 – 2007 – FENZ Heads up 3 Multi Storey Building – Auckland – A fire started in a library on the second floor of a seven-storey building. In addition to the library, the building housed a tavern, offices, a recreational area and 48 accommodation units.

[45] Frank, K. M., Baker, G. B. & Wade, C.A. (2019). Fire spread from lower roofs project: Final report. BRANZ Study Report SR409. Judgeford, New Zealand: BRANZ Ltd.

The bottom 3 floors were covered by a brigade-connected fire alarm system which had heat detection and manual call points.

The fire was only detected by the localised alarms approximately 30 seconds before an occupant on the fifth floor activated a manual call point.

Firefighters found wedged smoke doors that were allowing smoke to enter one of the stairwells. Multiple occupants were prevented from descending by smoke and travelled to the roof.

Firefighters assisted with carrying two occupants with mobility issues down the stairs and others were rescued from the roof of the building by an aerial appliance.

HFE 91 – 2010 – Thorndon Quay – Wellington – On 24 February, a fire occurred in an upper level of an office building requiring the evacuation of the entire building (Figure 10.). A total of 8 fire appliances responded. The location of this fire several floors above ground made firefighting challenging.

No one was injured in this fire.

Figure 10. Thorndon Quay Wellington – 24 February 2010 Photographer Edwin Coates, "QV5.JPG", via www.111emergency.co.nz, 2010, Used with permission.

HFE 92 – 2013 – 663 Princess Street – Kingston, Ontario, Canada – A fire during construction of this housing complex led to a dramatic helicopter rescue of a crane operator who was trapped for 2 hours while the fire burned below him.

The 6-storey timber building was referred to in planning sessions as the tinderbox due to its construction[46].

This fire negatively impacted the perception of safety of timber structures and lead to calls from the fire service to ban the construction of taller timber buildings in the province.

It took over a decade to permit tall timber structures in Ontario.

HFE 93 – 2015 – Takapuna Towers – Auckland – On 10 December, a fire occurred on the fifth, sixth, and seventh floors of a 15-storey commercial building.

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[46] National Post (2013-12-18), "Call in every available fighter: Tape reveals frantic response to Kingston blaze as chief warns crane could come crashing down". Accessed online from: https://nationalpost.com/news/canada/kingston-crane-still-standing-but-may-yet-collapse-citys-politicians-were-warned-about-tinderbox-building

Smoke from the fires filled the stairwell which required firefighters to retreat to the fourth floor while positive pressure ventilation was brought in. However, this was a petrol-powered fan and its use had to be discontinued due to concerns about carbon monoxide being introduced into the stair.

External fire spread between the floors was noted during the response and an aerial fire truck was used to help prevent further external fire spread. This fire highlighted the challenges of smoke spread in the stairwells as the building did not have a smoke control system. It also highlighted the potential for external fire spread in high-rise buildings.

HFE 94 – 2016 – Lacrosse – Melbourne, Victoria, Australia – A discarded cigarette ignited combustible cladding on the external wall of the 21-storey building.

The building was protected with sprinklers but the external fire still spread back into the building on different levels.

This fire led to changes in the Australian National Construction Code on the use and testing of external cladding products.

The fire was also one of the contributing factors which lead the Australian Government commissioning a review into the building regulatory system. The resulting Building Confidence report made a number of recommendations to reform the Australia building regulatory controls[47].

HFE 95 – 2017 – Grenfell Tower – London, England – One of the highest profile fires in the world, the fire in the 24 storey Grenfell Tower received world-wide media attention.

Seventy people died in the fire after a faulty refrigerator on the fourth floor ignited the cladding material on the outside of the building which quickly spread to all levels of the building. More than 250 firefighters responded to the fire and the fire burned for over 60 hours until it was put out.

This fire led to widespread reforms of building controls in the United Kingdom including the creation of a new Building Safety Act and Building Safety Regulator responsible for the safety of high-risk buildings[48].

This fire also prompted a world-wide response to better understand the:

- fire dynamics of combustible cladding systems, and
- the types of test methods that can be used to appropriately assess the performance of materials and cladding systems.

New Zealand's response included revisions to the acceptable solutions and verification methods in 2020.

HFE 96 – 2019 – International Conference Centre (Sky City) – Auckland – A fire occurred in the under construction International Conference Centre.

The most likely cause was hot work being undertaken on the roof.

The construction of the roof included combustible materials that allowed fire to grow and meant it was difficult to put out the fire.

Firefighting operations took multiple days with millions of litres of water used to control the fire. The water flooded the basement car parking levels and damaged many of the cars parked there.

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[47] Shergold, A.C., & Bronwyn, W. (2018), "Building Confidence Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia". Accessed online from: https://www.abcb.gov.au/initiatives/bcr

[48] Key recommendations following the Grenfell Tower fire can be found in Dame Judith Hackitt's independent review of building regulations and fire safety available online from: https://www.gov.uk/government/publications/independent-review-of-building-regulations-and-fire-safety-final-report

Smoke disrupted large parts of Auckland and caused widespread concern.

The hydrant system was reportedly only operational up to the second level of the building. This meant that large lengths of firefighting hose were required to get sufficient water to the roof of the building.

Only a single aerial appliance that could reach (but not extend above) the roof was available to attend the fire. This also limited the ability to apply water to the roof of the building.

The conference centre was substantially damaged. This fire highlighted:

- significant loss of societal amenity and potential national reputational impact
- major environmental and societal activity impact due to smoke spread and firefighting water runoff
- minimal building regulatory controls for fire safety in buildings under construction including the lack of fire safety systems operable at different stages
- limited fire service capability in dealing with a fire on the roof of a building
- no fire controls for roof systems or materials.

HFE 97 – 2020 – FENZ Heads up article 30 Fires in buildings under construction – This article contains examples of several fires during construction and some of the difficulties in attending the fires. Issues identified with these fires included:

- the building hydrant system were inoperative and in one incident there was 32-minute delay getting a hose line established
- hot works including welding, brazing, gas cutting had accidentally started several fires
- notification of a fire alarm was delayed by 50 minutes as the fire alarm system was isolated and did not activate
- lifts had been programmed for contractors' use and did not respond to override controls by the firefighters. This meant the lifts were unusable by the firefighters.

HFE 98 – 2024 – City Garden Apartments – Auckland – Auckland Council declared this 16-storey apartment building as a dangerous building because of several issues with the fire safety systems in the building.

On 19 April, Auckland Council lifted the dangerous building notice with recommendations to further remediate issues with the fire safety systems, passive fire protection, escape routes through the car park, and cladding on the building.[49]

B.1.8 Carparks

The historical fire events on carpark fires did not result in serious injuries or deaths. But they have highlighted concerns on carparks:

- design with low fire-resistance ratings, and
- with no (or a disabled) fire suppression systems.

In each case, the damage to the building and cars inside was extensive with significant monetary losses.

HFE 99 – 2017 – King's Dock – Liverpool, England – The carpark had a capacity for around 1400 vehicles and was full at the time of the fire. The structure had a 15-minute fire resistance rating and no sprinkler protection. The fire went un-noticed for 13 minutes, CCTV footage showed the first sign of smoke from the diesel-powered vehicle at 16:29. A member of the public called 999 and shortly afterwards and activated a manual call point. The event firefighting team arrived 2 minutes after the call point activation. Two appliances arrived on scene 5 minutes later, by which time the intensity and heat of the fire made it impossible to attack the fire internally.

[49] Auckland Council (2024-04-25), "City Garden apartment building update". Accessed online from: https://ourauckland.aucklandcouncil.govt.nz/news/2024/04/city-gardens-apartment-building-update/

The result was a total loss of the structure and around 1150 vehicles.

HFE 100 – 2020 – Stavanger Airport – Sola, Norway – The carpark had a capacity of 3000 vehicles, it was reported that the car park was full. The structural fire resistance rating was only 10 minutes for beams, as the risk of a multi-vehicle fire was seen as small and therefore the steel structure would not reach the limiting temperature. The structure was not sprinklered. A manual alarm call point was activated approximately 13 minutes after ignition. The airport fire and rescue responded with appliances arriving on the incident ground between 19 and 22 minutes after ignition. Structural failure began after 1 hour 37 minutes. The result was a partial loss of the structure and the loss of around 300 vehicles.

HFE 101 – 2023 – Luton Airport – Luton, England – The carpark had a capacity of 1300 vehicles and was full at the time of the incident. The structure had a 15-minute fire resistance rating and no sprinklers. A diesel vehicle caught fire while preparing to park. The fire service was notified quickly and responded within 10 minutes, consistent with the distance from the fire station to the airport. By this time, the fire was too intense for an internal attack. The result was a total loss of the structure and approximately 1200 vehicles.

HFE 102 – 2024 – Cheongna Apartment – Incheon, South Korea – The underground car park had a capacity of 2270 vehicles, with 116 electric vehicle chargers installed over 2 floors. The structure was concrete, but it is unclear what the fire resistance rating was. An alarm and sprinkler system were installed in the building. The alarm was triggered in the control room at 06:09 but an employee immediately activated the stop button for the sprinkler system before going to investigate.

The employee confirmed the fire had begun in an electric vehicle but by the time they returned to the control room and released the stop button (06:14), the fire had already compromised wiring resulting in the “normally dry” sprinkler system not operating, due to solenoids failing to activate.

The fire service took 8 hours and 20 minutes to put the fire out, resulting in the loss of 140 vehicles. Rivers of fuel were named as contributing to fire spread between floors. It is unknown at this point if the structure has been compromised beyond repair. It has resulted in a call for a limit on charging electric vehicles in underground carparks.

B.1.9 Wildfires in New Zealand

The Forest and Rural Fire Association of New Zealand provides a good summary of wildfire instances from 1840 to 1919[50]. Wildfires were present around the country throughout this time period with several notable fires affecting buildings.

There have been other more recent fires that have resulted to losses to buildings with the most significant at Lake Ōhau in 2020.

HFE 103 – 1872 – There was widespread drought and fires occurred across the country with buildings lost in Whangarei, Greytown, Reefton, Dunedin, Invercargill.

HFE 104 – 1879 – Carterton – Carterton was almost destroyed by a bush fire with significant efforts required to prevent the ignition of wooden roof shingles.

HFE 105 – 1885 to 1888 – There were extensive fires around the whole country with the village of Norsewood destroyed by fire and danger to Palmerston North and Stratford.

HFE 106 – 1896 – Carterton – Wildfires destroyed 9 houses, 9 mills, and numerous other outbuildings.

[50] Forest and Rural Fire Association of New Zealand (2004), “History 1840 – 1919”, Accessed on 2024-08-14 from http://frfanz.org.nz/history/1840-1919/

HFE 107 – 1897 to 1898 – Central New Zealand had a number of fires with Pahiatua severely damaged.

HFE 108 – 1907 to 1908 – Prolonged drought resulted in extensive fires including Southland, Canterbury, and Taranaki. There is a report of one firefighter fatality.

HFE 109 – 1918 – Raetihi – The town was destroyed and three people died with more people injured.

HFE 110 – 1955 – Balmoral forest fire – This forest fire originated from the mill where the building fire ignited the surrounding forest.

HFE 111 – 1971 – Lawrence scrub fire – This fire threatened homes and resulted in a declared state of emergency.

HFE 112 – 1999 – Alexandra wildfires – There were 4 fires ignited in the same afternoon near Alexandra resulting in an emergency declaration and the evacuation of about 200 people. Two houses were destroyed along with other farm buildings. One person died of a heart attack caused by shock after seeing the damage.

HFE 113 – 2017 – Port Hills fire – Christchurch – Fires in the Port Hills resulted in the death of one firefighter and the destruction of 9 homes and 2 other structures. Several hundred people were evacuated and the state of emergency was in place for 2 weeks.

HFE 114 – 2020 – Lake Ōhau – A fire swept through the Lake Ōhau Village and destroyed 48 homes and buildings. This is the most significant wildfire in recent history. The fire burned for 9 days. It was determined the fire was accidental and caused by an electrical short circuit on a power pole several kilometres upwind of the village.

B.2 Past reviews into the Building Code and fire safety provisions

B.2.1 Introduction of the Building Code in 1991

In 1991, the Building Industry Commission[51] recommended replacing locally adopted bylaws with a performance-based building code system that applied throughout New Zealand.

The old system had a plethora of bylaws, regulations, and other control documents. It focused on the means: technical solutions with detailed prescriptions for constructing buildings. The proposed Building Code took the approach of mandatory building clauses that are supported by non-mandatory technical solutions.

The Commission added performance sub-clauses to the code frameworks that had been used elsewhere to ensure the clauses would provide opportunities for both interpretation and alternative technical solutions.

Other codes that only had objectives and functional requirements were found to discourage innovation and were little better than making the technical solutions into law.

The commission found that some performance criteria could be quantified in ways that performance can be reliably predicted by calculation or verified by test. For example, requiring mechanical ventilation systems to be capable of changing the air in rooms a certain number of times each hour.

However, the Commission was unable to find ways to quantify or measure performance for every clause, either because no way could be identified or because the identified way would be too complicated and expensive to apply. For these requirements, the performance sub-clauses provided expanded descriptions of the features of the building that will meet the requirements.

The Commission's fire safety example suggested one way of protecting people from injury by fire is providing safe means of escape.

51 Building Industry Commission (Jan 1991) Reform of building controls: Report to the Minister of Internal Affairs

While performance may be best quantified using evacuation time, the wide range of variables would make reliable prediction too difficult. Evacuation time was not considered a useful metric because performance may only be verifiable once a building is constructed and on fire.

The performance requirements for means of escape were found to be more easily described in terms of capacity, fire and smoke resistance, and other relevant building features.

B.2.2 Fire safety provisions substantially changed in 2012

Following the passing of the Building Act 2004, a review of the Building Code was triggered by section 451 of the Building Act 2004. This review resulted in a consultation document in 2006 and published outcomes of the review called Building for the 21st Century Report on the Review of the Building Code.

The review recommended that the Building Code be amended to clarify performance requirements particularly for fire safety.

In 2010, there was public consultation on changes to the existing fire safety clauses C1-C4 and the introduction of new acceptable solutions and verification methods. This led to the creation of new clauses C1-C6 as well as 2 new verification methods (C/VM1 and C/VM2) and 7 new acceptable solutions (C/AS1 to C/AS7).

B.2.3 Multiple reviews of fire safety provisions in the Building Code in the past 30 years

There have been multiple reviews commissioned to look at the fire safety provisions and in the Building Code which provided a variety of recommendations. We have summarised these reports in the table below. These documents were reviewed in the preparation of this discussion document.

Concerns about the fire safety clauses in the Building Code and perceived conflicts in the legislative frameworks were also raised in a complaint to the Regulation Review Committee in June 2023 by Mr. Christian van der Pump and Associate Professor Eric Scheepbouwer.

Report	Date	Authors and document name	Description of the document
R001	1997-08-07	Worcester Polytechnic Institute - Hubbard, D. B. Jr., Pastore, T. M., New Zealand Building Regulations Five Years Later	Recommendations to improve the use of the performance-based building code. Includes interviews with sector participants.
R002	2002-01-01	C.R. Barnett and C.A. Wade, A Regulatory Approach to Determine Fire Separation Between Buildings Using the Limiting Distance Method	Background and assumptions on the separation of houses in the New Zealand Building Code.
R003	2006-05-01	Department of Building and Housing, Building for the 21st century Review of the Building Code	A review of the Building Code triggered by section 451 of the Building Act 2004. It documents the intent for a performance-based code and contains objectives for fire safety.
R004	2006-07-31	Brian Meacham, Quantifying Fire Performance Criteria for the New Zealand Building Code	Internal discussion paper on various issues related to quantifying performance criteria for the Building Code. It includes discussion of risk-based criteria and performance levels (importance levels).
R005	2006-08-01	Brian Meacham, Towards Development of Codified Design Fires for Use in Performance-Based Building Regulation	Design fire loads for establishing performance levels in the Building Code

Appendix B. Lessons learned from the past

Report	Date	Authors and document name	Description of the document
R006	2007-01-01	Justin Lester, Using Risk-based evidence to express performance standards in the Building Code	What risk assessment means, how it can be used to apply a quantified approach to performance within the New Zealand Building Code, and describes possible risk metrics for the Code
R007	2007-10-04	Arup - Brian Meacham, Building Code Review Comments on Discussion Document	An external review of a draft performance framework and performance criteria prepared by the Department of Building and Housing in the Building for the 21st Century 2006 discussion document.
R008	2007-11-01	Department of Building and Housing, Building for the 21st Century Report on the Review of the Building Code	Report on the outcome of public consultation on the 2006 Discussion document. The review recommended that the Building Code be amended to clarify performance requirements particularly for fire safety.
R009	2008-05-10	Brian Meacham, Fire Performance Quantification in the New Zealand Building Regulations: Current Situation and Plan Forward	Recommendations on a plan forward to breaking new ground from a fire safety regulatory perspective (in terms of quantifying fire loads and criteria as regulatory requirements rather than allowing the decision to be made on a per-project basis) within the next 2 years. The concepts in the document where to be tested with stakeholders and the DBH Fire Advisory Committee.
R010	2008-11-01	Delwyn Lloydd, Evaluation of the Conceptual Framework for performance-based fire engineering design in New Zealand	Thesis from University of Canterbury that included analysis of 12 buildings to provide a risk comparison for life safety for the conceptual performance framework. It outlines some of the calculations and references used in C/VM2.
R011	2008-12-31	DBH - Ian Miller, New Zealand Building Code Regulations: Fire performance quantification - Human behaviour factors and the New Zealand Fire Performance Code	Relationship between human behavioural factors and the NZ Building Code for fire. Produced as an output from Meacham 2008.
R012	2010-01-01	VUW Thesis: Peter Mumford, Enhancing performance-based regulation: lessons from New Zealand's Building Control system	Explores 2 strategies for resolving the challenges of decision-making in a permissive performance-based regulatory environment: improving the predicative capability of decision-making systems through the better application of the intuitive judgment associated with expertise and wisdom, and treating novel technologies as explicit experiments.
R013	2010-09-01	DBH, Proposed changes to Building Code requirements and associated documents for protection from fire	Consultation on changes to C1-C4 and the introduction of new acceptable solutions and verification methods.
R014	2010-09-01	DBH, Proposed changes to the Acceptable Solution for Building Code clause F7 (Warning Systems)	Consultation on changes to F7.

Appendix B. Lessons learned from the past

Report	Date	Authors and document name	Description of the document
R015	2011-06-01	Chin Hung (Marco) Yip, Applying the New Zealand Performance Based Design Fire Framework to Buildings Designed in Accordance with NFPA 5000	Thesis from University of Canterbury that included case studies of the performance-based fire design framework in New Zealand before it was published in regulations.
R016	2011-06-01	Sapere - David Moore and Carole Canler, Review of the Building Code System: Options for future development	Strengths and weaknesses of Building Code system and opportunities to improve to reflect the intent of the Building Act 2004.
R017	2014-07-17	Tony Enright, Risk and the Regulator Part 1: A Short Introduction to Risk Principles	Principles for incorporating risk in the Building Code
R018	2014-09-24	Tony Enright, Risk and the Regulator Part 2: Risk-informed Elements in the Existing Building Regulations	Principles for incorporating risk in the Building Code
R019	2014-10-05	Brian Meacham, MBIE External Review of Fire Provisions – Preliminary Comments	A written assessment that considers: do the Building Code C Clause performance objectives meet the Code functional objectives?
R020	2015-02-20	MBIE, New Zealand Building Code Clause B1-Structure Amendment Comparison of Building Importance Levels (BILs) between Section 3 AS/NZS1170.0 Table 3.1 and Table 3.2 and Building Code Clause A3	Contains a summary of issues in 1170 and A3 and the differences between the definitions of importance levels.
R021	2015-04-20	Tony Enright, Risk and the Regulator Part 3: The Next Generation Risk Framework for New Zealand's Building Regulations	Principles for incorporating risk in the Building Code
R022	2016-04-13	Brian Meacham, New Zealand Building Fire Regulatory System Review	An external review of the MBIE programme to review the fire regulations development and assess the relevancy and priority of the work in train.
R023	2017-02-28	MBIE, Approval to Release Discussion document: Consultation on Fire Safety Proposals	Cabinet paper seeking approval to release the 2017 Fire consultation.
R024	2017-07-01	MBIE, Consultation on fire safety proposals	Consultation on proposed changes to surface finishes (C3.4) and structural performance in fire (C6).
R025	2018-11-30	ThinkPlace, Smarter Compliance pathways: Enhancing clarity, consistency, and certainty of the Building Code	Report summarising comments from stakeholders to identify opportunities for user-centric and future-focused compliance pathways.

Appendix B. Lessons learned from the past

Report	Date	Authors and document name	Description of the document
R026	2020-09-01	International Building Quality Centre, Principles for Good Practice Building Regulation	Principles of good practice building regulation to ensure public safety and maintain regulatory efficiency and innovation.
R027	2007-08-01	Fire Engineering Advisory Taskforce, Hot topics Report and Recommendations	Recommendations by those involved in the fire engineering design of buildings to give clarity about the fire engineering design process.
R028	2021-04-04	Thomas Fire Engineering Ltd, Dr. Geoff Thomas, C/VM2 Revision project Structural Fire Engineering	Review of structural fire engineering practice in the New Zealand Building Code.
R029	2021-09-30	Fire Research Group, Dr. Colleen Wade, PTL Structural Consultants, Dr. Andrew Buchanan, Fire design of mass timber buildings for compliance with the NZBC	Review of current requirements in C/AS2 and C/VM2 and what changes might be necessary to ensure an adequate level of fire safety and structural fire performance of mass timber buildings.
R030	2023-10-27	Timber Unlimited, Fire safety in multi-storey mass timber structures	Recommendations for multi-storey mass timber structures to supplement the use of NZ Building Code Acceptable Solution C/AS2 and Verification Method C/VM2.

Appendix C. Comparison to international building codes

C.1 MBIE's desktop review of building codes from overseas

C.1.1 MBIE's review focused on international building code frameworks

MBIE's desktop analysis of overseas codes and regulations compared the fire safety provisions set in mandatory regulations in New Zealand to similar building code frameworks in other countries.

The review was not to:

- see what gaps existed in New Zealand's building code in comparison to other jurisdictions, or
- an in-depth analysis of all Building Codes internationally.

The review only looked at building code provisions for:

- fire safety
- aspects of codes for buildings but only related to structural fire provisions
- access and circulation within buildings, and prevention of ignition

These codes provide a good comparison of what is used in different jurisdictions.

Codes and documents reviewed were those similar to New Zealand's frameworks and included:

- Australian Building Codes Board – National Construction Code 2022, Volumes 1, 2, and 3
- International Code Council – 2024 ICC Performance code for Buildings and Facilities (ICCPC) along with the International Building Code and International Residential Code
- National Fire Protection Association NFPA 101® Life Safety Code® 2024
- Canadian Commission on Building and Fire Codes – National Building Code of Canada 2020 Volumes 1 and 2
- United Kingdom – Building Regulations 2010 Schedule 1 Requirements as of 28 May 2024
- The World Bank – Building Code Checklist for fire safety, 2023

Each requirement in the overseas code was analysed to establish:

1. Does a similar requirement exist in the New Zealand Building Code clauses?

2. Is this matter within the scope of the New Zealand Building Act/Building Code or is it regulated in another way in New Zealand?

3. Is there an appreciable difference between the requirement in New Zealand and the requirement overseas that impacts the design outcome of the building?

This desktop analysis only listed the items that were identified as gaps and were evaluated as 'yes' to those three questions.

Other items that were evaluated and not identified as gaps are not included in this background paper.

C.1.2 Review was limited to building codes from similar jurisdictions

MBIE's desktop analysis did not consider other features of the building regulatory systems in these countries that sit outside the scope of the Building Code in New Zealand. But it is acknowledged that maintaining fire safety spans across multiple building acts and participants in the system. For instance, the UK has undergone significant changes to their building regulatory system since the Grenfell tower fire in 2017. This includes the introduction of a building safety regulator and definitions for higher risk buildings.

The scope of this document is on the performance of buildings as building work under the New Zealand Building Code. Items that are not within the scope of this review include:

- Operation and maintenance of fire safety systems which are covered under the building warrant of fitness regime.
- Operation of existing facilities for the storage of dangerous goods which may appear in fire codes internationally.
- Training of staff or evacuation procedures for certain buildings as these requirements are covered by other regulations (such as the Fire and Emergency New Zealand (Fire Safety, Evacuation Procedures, and Evacuation Schemes) Regulations 2018).
- Matters related to the consenting, approvals of buildings, or the type of documentation that must be submitted for an application.
- Restrictions on the activities that individual may undertake (occupational regulation).

Additionally, while the World Bank checklist is not enforceable itself, it includes a detailed discussion on approaches to fire safety provisions in building fire regulations and includes information such as key fire safety components in building/fire regulations.

The International Building Quality Centre also provides information to support the development of best practice building regulatory policy guidelines. It is not the intention here to cover off all aspects of good regulatory policy design and this would be considered in further details when developing technical policy options as part of the wider fire safety regulatory review programme.

Other countries and code that were not reviewed in depth but may contain useful features for development of future policy option include:

- The UK Building Safety Act 2022
- The Building (Scotland) Regulations 2004
- Prescriptive requirements for fire and life safety in the National Fire Protection Association codes NFPA 5000 and NFPA 101, and the United Arab Emirates Fire and Life Safety Code of Practice
- Performance-based frameworks from Sweden, The Netherlands, Singapore, and Hong Kong.

C.1.3 Review focus on the high level frameworks and requirements

The focus of the review was the requirements in the highest level of the frameworks such as the objectives, functional requirements, and performance criteria which may be mandatory for demonstrating compliance.

Where applicable, comments have also been provided on high-level comparison of the prescriptive requirements. But this does not list all aspects and differences between the various prescriptive requirements.

C.2 Key finding from other building codes

C.2.1 Other frameworks are less quantified than New Zealand and more comprehensive

In comparison to New Zealand, the other building code frameworks reviewed contained less quantified performance criteria and, instead, provide principles for fire safety along with enabling provisions to specify the types of things that must be considered in the design of buildings.

Appendix C. Comparison to building codes from overseas

The principle-based approach to building regulations appears to be more comprehensive than the requirements provided in New Zealand and are more clear on what is expected to maintain fire safety in a building.

The largest differences are for basic fire safety features such as means of escape, fire safety systems including fire alarms and suppression, and facilities for firefighting operations. Other codes provide more information on both:

- when a feature is required; and
- how the system must perform when it is required.

Other codes and framework also have more considerations for the unique circumstances of each building so that the requirements are proportionate to the risk. This includes separate considerations on the use of the building, the height of the building, the features of the building, the fire hazards present, and the occupants present.

In the case of the ICC, some of the requirements also refer to specific performance levels for the building to determine the stringency of the requirements.

Other codes also have specific sections designed for residential housing where the New Zealand Building Code fire safety provisions only addresses residential buildings by exception.

Other key areas where the other building codes are missing specific requirements include:

- fire hazards and prevention including fire involving hazardous substances;
- fire safety of a building during construction;
- the use of lifts for occupant evacuation and firefighting;
- occupants with disabilities; and
- occupants in care and detention facilities where evacuation can be difficult.

The New Zealand Building Code clauses also have gaps specifying the interaction between parts of the code including the interaction with structural design, building services, and access into and around the building.

It is unclear what level of intervention or contribution firefighters are expected to make in minimising the outcomes of the fire and how that is factored into regulatory requirements to meet objections for life safety and property protection.

The lack of interaction and coordination can result in gaps in the complete design of the building. This is found in performance-based designs as the performance criteria are considered in isolation and not as a whole

C.2.2 Differences in the prescriptive requirements for each code

Where other building codes are more comprehensive, this translates into additional features in the prescriptive requirements. Summaries of these additional prescriptive requirements are:

- Canada and the NFPA have included explanatory material within the document, which ensures that if a requirement changes, any informational text (guidance) must be updated as well.
- Other than New Zealand, no other building code has offices in the same category as storage or processing plants (risk group WB). Most have various subcategories of hazardous occupancies, depending on the activity or amount and type of hazardous substances in the building.
- For residential buildings:
  - Fire resistance ratings in other codes are generally higher than those specified in New Zealand.
  - The UK, Canada, IRC and NFPA 101 ask for a second means of escape from bedrooms.
  - The IRC and NFPA 101 require sprinklers to be installed in new dwellings.
- Fire spread and structural fire safety

  - All other codes have further requirements as the building increases in either height, or number of stories or volume/floor area.
  - The requirements for internal surface finishes are mostly the same across the codes.
  - All the reviewed codes except the UK and New Zealand have requirements based on the construction type and include sections for the use of timber (including mass or heavy timber).
  - All the reviewed codes specify fire ratings for the different elements, such as loadbearing and non-loadbearing structural elements, between compartments and buildings, and for escape routes.
  - For all reviewed codes but not New Zealand, the fire ratings increase as the building gets taller.
- Fire safety systems
  - New Zealand has a higher threshold where alarm-connected smoke detection is required but does ask for full building coverage.
  - The IBC and Canada require visual alerting devices (VADs) in public corridors while NFPA 101 requires VADs in lodging and boarding houses. New Zealand does not require VADs in any building.
  - Canada requires sprinklers in buildings over 3 storeys, where New Zealand and the other codes have these set for building height thresholds of 25 or 30 m.
  - All codes require care occupancies to be sprinklered.
  - All codes allow for lower fire resistance ratings if sprinklers are installed in buildings.
  - Other codes have requirements for smoke control systems (including smoke venting or air pressurisation, or both) to aid evacuation and firefighters in certain buildings. The UK has does not require these features but has other concessions where smoke control systems are installed.
- Evacuation and means of escape
  - For means of escape, New Zealand and all except Australia ask for at least 2 exits. Where there are over 500 occupants, New Zealand progressively ask for more exits as the occupant load increases than the other codes do.
  - The travel distances permitted in New Zealand are generally much longer than the other codes allow, especially for the industrial and high hazard occupancies where the maximum travel distance may be 180 m vs 25 to 40 m in other countries.
- Emergency response
  - Unlike the other codes, New Zealand has no requirements for hose reels, firefighting lobbies, shafts, lifts, or control/command centres and no provision for an adequate water supply (although building hydrants are required).

C.3 Australia National Construction Code 2022

C.3.1 Australia has a performance based code

The National Construction Code (NCC) is Australia's primary set of technical design and construction provisions for buildings. The NCC was last updated in 2022. It contains 3 volumes that are separated to cover some residential buildings, all other buildings, and plumbing and drainage systems.

The NCC is performance based. As a performance-based code, it sets the minimum required level for the safety, health, amenity, accessibility, and sustainability of buildings. The Australian Building Codes Board, on behalf of the Australian Government and each State and Territory government, produces and maintains the National Construction Code. Individual State and Territory may include modifications to the requirements for their jurisdiction.

The NCC has a similar structure and format as New Zealand with objectives, functional requirements, performance criteria along with prescriptive requirements and verification methods that can be used to satisfy the requirements.

C.3.2 Gaps in the New Zealand Building Code clauses for fire safety in comparison to the NCC

ID	Requirement	Type	Comments on the gaps
NCC 1	C Fire resistance The Objective of Parts C1, C2, C3 and C4 is to— (a) safeguard people from illness or injury due to a fire in a building; and (b) safeguard occupants from illness or injury while evacuating a building during a fire; and (c) facilitate the activities of emergency services personnel; and (d) avoid the spread of fire between buildings; and (e) protect other property from physical damage caused by structural failure of a building as a result of fire	Objective	Objectives (d) and (e) are more specific to the fire than C1 in NZBC.
NCC 2	C Fire resistance C1F2 Prevention of fire spread A building is to be provided with safeguards to prevent fire spread— (a) so that occupants have time to evacuate safely without being overcome by the effects of fire; and (b) to allow for fire brigade intervention; and (c) to sole-occupancy units providing sleeping accommodation; and (d) to adjoining fire compartments; and (e) between buildings.	Functional requirement	Specific about the reasons to prevent fire spread.
NCC 3	C Fire resistance C1P1 Structural stability during fire A building must have elements which will, to the degree necessary, maintain structural stability during a fire appropriate to— (a) the function or use of the building; and (b) the fire load; and (c) the potential fire intensity; and (d) the fire hazard; and (e) the height of the building; and (f) its proximity to other property; and (g) any active fire safety systems installed in the building; and (h) the size of any fire compartment; and (i) fire brigade intervention; and (j) other elements they support; and (k) the evacuation time.	Performance	The list of criteria is not included in C6. C6 is limited and does not consider: (a), (d), (e), (f), (h), (i), (k)
NCC 4	C Fire resistance C1P2 Spread of fire A building must have elements which will, to the degree necessary, avoid the spread of fire— (a) to exits; and (b) to sole-occupancy units and public corridors; and (c) between buildings; and (d) in a building.	Performance	There are no specific requirements in the NZBC for fire separations.

ID	Requirement	Type	Comments on the gaps
	(2) Avoidance of the spread of fire referred to in (1) must be appropriate to— (a) the function or use of the building; and (b) the fire load; and (c) the potential fire intensity; and (d) the fire hazard; and (e) the number of storeys in the building; and (f) its proximity to other property; and (g) any active fire safety systems installed in the building; and (h) the size of any fire compartment; and (i) fire brigade intervention; and (j) other elements they support; and (k) the evacuation time.		
NCC 5	C Fire resistance C1P3 Spread of fire and smoke in health and residential care buildings A building must be protected from the spread of fire and smoke to allow sufficient time for the orderly evacuation of the building in an emergency.	Performance	This is an additional requirement to limit smoke in health and residential care.
NCC 6	C Fire resistance C1P4 Safe conditions for evacuation To maintain tenable conditions during occupant evacuation, a material and an assembly must, to the degree necessary, resist the spread of fire and limit the generation of smoke and heat, and any toxic gases likely to be produced, appropriate to— (a) the evacuation time; and (b) the number, mobility and other characteristics of occupants; and (c) the function or use of the building; and (d) any active fire safety systems installed in the building.	Performance	Covered by C4 but this requirement identifies the characteristics of the occupants to be considered.
NCC 7	C Fire resistance C1P5 Behaviour of concrete external walls in fire A concrete external wall that could collapse as a complete panel (e.g. tilt-up and pre-cast concrete) must be designed so that in the event of fire within the building the likelihood of outward collapse is avoided.	Performance	This is a specific requirement for concrete.
NCC 8	C Fire resistance C1P7 Fire protection of emergency equipment A building must have elements, which will, to the degree necessary, avoid the spread of fire so that emergency equipment provided in a building will continue to operate for a period of time necessary to ensure that the intended function of the equipment is maintained during a fire.	Performance	Continued operation of equipment during a fire.
NCC 9	C Fire resistance C1P8 Fire protection of openings and penetrations	Performance	Addresses fire stopping of penetrations

ID	Requirement	Type	Comments on the gaps
	Any building element provided to resist the spread of fire must be protected, to the degree necessary, so that an adequate level of performance is maintained— (a) where openings, construction joints and the like occur; and (b) where penetrations occur for building services.		
NCC 10	C Fire resistance C1P9 Fire brigade access Access must be provided to and around a building, to the degree necessary, for fire brigade vehicles and personnel to facilitate fire brigade intervention appropriate to— (a) the function or use of the building; and (b) the fire load; and (c) the potential fire intensity; and (d) the fire hazard; and (e) any active fire safety systems installed in the building; and (f) the size of any fire compartment.	Performance	Considers firefighting access to consider different building types.
NCC 11	D Access and Egress D1P4 Exits Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to— (a) the travel distance; and (b) the number, mobility and other characteristics of occupants; and (c) the function or use of the building; and (d) the height of the building; and (e) whether the exit is from above or below ground level.	Performance	Specific on what is required for exits
NCC 12	D Access and Egress D1P5 Fire-isolated exits To protect evacuating occupants from a fire in the building exits must be fire-isolated, to the degree necessary, appropriate to— (a) the number of storeys connected by the exits; and (b) the fire safety system installed in the building; and (c) the function or use of the building; and (d) the number of storeys passed through by the exits; and (e) fire brigade intervention.	Performance	Specific on what is required for fire-isolated exits.
NCC 13	D Access and Egress D1P6 Paths of travel to exits So that occupants can safely evacuate the building, paths of travel to exits must have dimensions appropriate to— (a) the number, mobility and other characteristics of occupants; and (b) the function or use of the building.	Performance	Specific on what is required to reach an exit

ID	Requirement	Type	Comments on the gaps
NCC 14	D Access and Egress D1P7 Evacuation lifts Where a lift is intended to be used in addition to the required exits to assist occupants to evacuate a building safely, the type, number, location and fire-isolation must be appropriate to— (a) the travel distance to the lift; and (b) the number, mobility and other characteristics of occupants; and (c) the function or use of the building; and (d) the number of storeys connected by the lift; and (e) the fire safety system installed in the building; and (f) the waiting time, travel time and capacity of the lift; and (g) the reliability and availability of the lift; and (h) the emergency procedures for the building.	Performance	Contains provisions for evacuation lifts.
NCC 15	D Access and Egress D1P9 Communication systems for people with hearing impairment An inbuilt communication system for entry, information, entertainment, or for the provision of a service, must be suitable for occupants who are deaf or hearing impaired.	Performance	Specific requirements for hearing impaired.
NCC 16	E Services and equipment – Fire fighting Equipment E1O1 The Objective of this Part is to— (a) safeguard occupants from illness or injury while evacuating during a fire; and (b) provide facilities for occupants and the fire brigade to undertake fire-fighting operations; and (c) prevent the spread of fire between buildings.	Objective	No objectives or requirements to provide means for occupants to undertake fire-fighting. Fire-fighting in the NZBC does not link to preventing the spread of fire between buildings.
NCC 17	E Services and equipment – Firefighting equipment E1F1 A building is to be provided with fire-fighting equipment to safeguard against fire spread— (a) to allow occupants time to evacuate safely without being overcome by the effects of fire; and (b) so that occupants may undertake initial attack on a fire; and (c) so that the fire brigade have the necessary equipment to undertake search, rescue and fire-fighting operations; and (d) to other parts of the building; and (e) between buildings.	Functional requirement	No functional requirements for occupants to undertake fire-fighting. Fire-fighting in the NZBC does not link to preventing the spread of fire between buildings.
NCC 18	E Services and equipment – Firefighting equipment E1P1 Fire hose reels A fire hose reel system must be installed to the degree necessary to allow occupants to safely undertake initial attack on a fire appropriate to—	Performance	No requirements for hose reels in NZBC.

ID	Requirement	Type	Comments on the gaps
	(a) the size of the fire compartment; and (b) the function or use of the building; and (c) any other fire safety systems installed in the building; and (d) the fire hazard.		
NCC 19	E Services and equipment – Firefighting equipment E1P2 Fire extinguishers Fire extinguishers must be installed to the degree necessary to allow occupants to undertake initial attack on a fire appropriate to— (a) the function or use of the building; and (b) any other fire safety systems installed in the building; and (c) the fire hazard.	Performance	No requirements for fire extinguishers in NZBC.
NCC 20	E Services and equipment – Firefighting equipment E1P3 Fire hydrants A fire hydrant system must be provided to the degree necessary to facilitate the needs of the fire brigade appropriate to— (a) fire-fighting operations; and (b) the floor area of the building; and (c) the fire hazard.	Performance	No specific requirements for internal or external fire hydrants in NZBC.
NCC 21	E Services and equipment – Firefighting equipment E1P4 Automatic fire suppression systems An automatic fire suppression system must be installed to the degree necessary to control the development and spread of fire appropriate to— (a) the size of the fire compartment; and (b) the function or use of the building; and (c) the fire hazard; and (d) the height of the building.	Performance	No requirements for a suppression system in the NZBC.
NCC 22	E Services and equipment – Firefighting equipment E1P5 Fire-fighting services in buildings under construction Suitable means of firefighting must be installed to the degree necessary in a building under construction to allow initial fire attack by construction workers and for the fire brigade to undertake attack on the fire appropriate to— (a) the fire hazard; and (b) the height the building has reached during its construction.	Performance	No requirements for firefighting during construction in the NZBC.
NCC 23	E Services and equipment – Firefighting equipment E1P6 Fire control centres Suitable facilities must be provided to the degree necessary in a building to co-ordinate fire brigade intervention during an emergency appropriate to— (a) the function or use of the building; and (b) the floor area of the building; and (c) the height of the building.	Performance	No requirement for a fire control centre in the NZBC.

ID	Requirement	Type	Comments on the gaps
NCC 24	E Services and equipment – Firefighting equipment E1P7 Automatic fire detection system (Tasmania) An automatic fire detection system must be installed to the degree necessary to alert the fire brigade of fire so that fire fighting operations may be undertaken at the earliest possible time to limit property and environmental damage appropriate to— (a) the building functions and use; and (b) the fire hazard; and (c) the height of the building; and (d) the building floor area.	Performance	No requirements for FF notification in the NZBC. This only exists in the standards.
NCC 25	E Services and equipment – Smoke hazard management E2P2 Safe evacuation routes (1) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building so that— (a) the temperature will not endanger human life; and (b) the level of visibility will enable the evacuation route to be determined; and (c) the level of toxicity will not endanger human life. (2) The period of time occupants take to evacuate referred to in (1) must be appropriate to— (a) the number, mobility and other characteristics of the occupants; and (b) the function or use of the building; and (c) the travel distance and other characteristics of the building; and (d) the fire load; and (e) the potential fire intensity; and (f) the fire hazard; and (g) any active fire safety systems installed in the building; and (h) fire brigade intervention.	Performance	No specific considerations in the NZBC for what safe evacuation routes must consider. C3.9, C4.5 are not this specific.
NCC 26	E Services and equipment – Lift installations E3O1 The Objective of this Part is to— (a) facilitate the safe movement of occupants; and (b) facilitate access for emergency services personnel to carry out emergency procedures and assist in the evacuation of occupants.	Objective	No requirements in the NZBC for the use of lifts in emergency by occupants or firefighters or other responders. D2 only relates to normal use of a building.
NCC 27	E Services and equipment – Lift installations E3F2 Emergency lifts A building is to be provided with one or more passenger lifts to facilitate— (a) the safe access for emergency services personnel; and (b) safe and easy evacuation of occupants who due to illness, injury or disability cannot use stairways in the	Functional requirement	No requirements in the NZBC for the use of lifts in emergency by occupants or firefighters or other responders. D2 only relates to normal use of a building.

ID	Requirement	Type	Comments on the gaps
	event of an emergency.		
NCC 28	E Services and equipment – Lift installations E3F3 Emergency alerts A building having a passenger lift is to be provided with measures to alert occupants about the use of the lift in an emergency.	Functional requirements	No requirements for emergency lifts so no consequential requirements for alerting.
NCC 29	E Services and equipment –Lift installations E3P1 Stretcher facilities Stretcher facilities must be provided, to the degree necessary— (a) in at least one emergency lift required by E3P2; or (b) where an emergency lift is not required and a passenger lift is provided, in at least one lift, to serve each floor in the building served by the passenger lift.	Performance	No requirements for stretchers in the NZBC.
NCC 30	E Services and equipment – Lift installations E3P2 Emergency lifts One or more passenger lifts fitted as emergency lifts to serve each floor served by the lifts in a building must be installed to facilitate the activities of the fire brigade and other emergency services personnel.	Performance	No requirements in the NZBC for the use of lifts in emergency by occupants or firefighters or other responders. D2 only relates to normal use of a building. C5.6 doesn’t refer to the type of access required.
NCC 31	E Services and equipment – Emergency lifts E3P3 Emergency alerts Signs or other means must be provided to alert occupants about the use of a lift during an emergency.	Performance	No requirements for emergency lifts so no consequential requirements for alerts.
NCC 32	E Services and equipment – Visibility in an emergency, exit signs and warning systems E4P3 To warn occupants of an emergency and assist evacuation of a building, an emergency warning and intercom system must be provided, to the degree necessary, appropriate to— (a) the floor area of the building; and (b) the function or use of the building; and (c) the height of the building.	Performance	Similar to F7. However, there are no provisions for intercom systems in the NZBC.
NCC 33	G Ancillary Provisions - Boilers, pressure vessels, heating appliances, fireplaces, chimneys and flues G2P1 Combustion heating appliances Where provided in a building, a combustion appliance and its associated components, including an open fire-place, chimney, flue, chute, hopper or the like, must be installed— (a) to withstand the temperatures likely to be generated by the appliance; and	Performance	Similar to C2.2 but more specific references to include chimneys, flues, chutes, etc. C2.2 does not include (a) and (c)

ID	Requirement	Type	Comments on the gaps
	(b) so that it does not raise the temperature of any building element to a level that would adversely affect the element's physical or mechanical properties or function; and (c) so that hot products of combustion will not— (i) escape through the walls of the associated components; and (ii) discharge in a position that will cause fire to spread to nearby combustible materials or allow smoke to penetrate through nearby windows, ventilation inlets, or the like.		
NCC 34	G Ancillary provisions – Construction in alpine areas G4O1 The Objective of this Part is to safeguard occupants in alpine areas from illness or injury from an emergency while evacuating a building.	Objective	No special considerations in the NZBC for alpine regions or local weather except for thermal comfort/wind loadings.
NCC 35	G Ancillary provisions – Construction in alpine areas G1F1 A building in an alpine area is to be provided with additional measures in view of the increased difficulties in fire-fighting and maintaining access and means of egress in snow conditions.	Functional requirement	No special considerations in the NZBC for alpine regions or local weather except for thermal comfort/wind loadings.
NCC 36	G Ancillary provisions – Construction in alpine areas G4P1 External doorways An external doorway from a building in an alpine area must be installed so that opening the door is not obstructed by snow or ice.	Performance	No special considerations in the NZBC for alpine regions or local weather except for thermal comfort/wind loadings.
NCC 37	G Ancillary provisions – Construction in alpine areas G4P2 Structures forming pathways in snow conditions A building in an alpine area containing external trafficable structures forming part of the means of egress must be constructed so that those structures remain, as far as practicable, useable under snow conditions.	Performance	No special considerations in the NZBC for alpine regions or local weather except for thermal comfort/wind loadings.
NCC 38	G Ancillary provisions – Construction in alpine areas G4P3 Control of falling ice and snow A building in an alpine area must be constructed so that snow or ice is not shed from the building onto the allotment, any adjoining allotment, road or public space in a location or manner that will— (a) obstruct a means of egress from any building to a road or open space; or (b) otherwise endanger people.	Performance	No special considerations in the NZBC for alpine regions or local weather except for thermal comfort/wind loadings.
NCC 39	G Ancillary provisions – Construction in alpine areas G4P4 Fire safety systems in alpine areas	Performance	No special considerations in the

ID	Requirement	Type	Comments on the gaps
	A building in an alpine area must have a fire safety system installed to— (a) facilitate fire-fighting operations; and (b) alert occupants in the event of an emergency.		NZBC for alpine regions or local weather except for thermal comfort/wind loadings.
NCC 40	G Ancillary provisions – Construction in bushfire prone areas G5O1 The Objective of this Part is to— (a) safeguard occupants from injury from the effects of a bushfire; and (b) protect buildings from the effects of a bushfire; and (c) facilitate temporary shelter for building occupants who may be unable to readily evacuate the building prior to a bushfire.	Objective	No special considerations in the NZBC for local effects such as bushfire.
NCC 41	G Ancillary provisions – Construction in bushfire prone areas G5F1 Construction in bushfire prone areas A building constructed in a designated bushfire prone area— (a) is to provide a resistance to bushfires in order to reduce the danger to life and minimise the risk of the loss of the building; and (b) if occupied by people who may be unable to readily evacuate the building prior to a bushfire, is to be constructed so as to provide its occupants shelter from the direct and indirect actions of a bushfire.	Functional requirement	No special considerations in the NZBC for local effects such as bushfire.
NCC 42	G Ancillary provisions – Construction in bushfire prone areas G5P1 Bushfire resistance A building that is constructed in a designated bushfire prone area must be designed and constructed to— (a) reduce the risk of ignition from a design bushfire with an annual exceedance probability not more than 1:100 years, or 1:200 years for a Class 9 building; and (b) take account of the assessed duration and intensity of the fire actions of the design bushfire; and (c) be designed to prevent internal ignition of the building and its contents; and (d) maintain the structural integrity of the building for the duration of the design bushfire.	Performance	No special considerations in the NZBC for local effects such as bushfire.
NCC 43	G Ancillary provisions – Construction in bushfire prone areas G5P2 Additional bushfire requirements for certain class 9 buildings A building that is constructed in a designated bushfire prone area and occupied by people who may be unable to readily evacuate the building prior to a bushfire must, to the degree necessary—	Performance	No special considerations in the NZBC for local effects such as bushfire-

ID	Requirement	Type	Comments on the gaps
	(a) reduce the risk of an untenable indoor environment for occupants during a bushfire event, appropriate to the— (i) location of the building relative to fire hazards, including— (A) classified vegetation; and (B) adjacent buildings, structures and movable objects; and (C) carparking areas and allotment boundaries; and (D) other combustible materials; and (ii) number of occupants to be accommodated within the building; and (iii) intensity of bushfire attack on the building; and (iv) duration of occupancy; and (v) intensity of potential consequential fires; and (vi) occupant tenability within the building before, during and after the bushfire event; and (vii) combined effects of structural, fire exposure and other effects to which the building may reasonably be subjected; and (viii) provision of fire fighting equipment and water supply to facilitate protection of the building; and (b) be provided with vehicular access to the site to enable firefighting and emergency personnel to defend or evacuate the building; and (c) have access to a sufficient supply of water for firefighting purposes on the site; and (d) provide safe access within the site to the building (including carparking areas), as well as safe egress after the bushfire event.		
NCC 44	Volume 2 Section H Class 1 and 10 buildings – Fire safety H3P1 Spread of fire (1) A Class 1 building must be protected from the spread of fire such that the probability of a building not being able to withstand the design heat flux of 92.6 kW/m^2 for a period of 60 minutes shall not exceed 0.01, when located within 900 mm from the allotment boundary or within 1.8 m from another building on the same allotment from— (a) another building other than an associated Class 10 building; and (b) the allotment boundary, other than a boundary adjoining a road or public space (see Figure H3P1). (2) A Class 10a building must not significantly increase the risk of fire spread between Class 2 to 9 buildings.	Performance	Incorporates risk-based performance criteria but uncertain on usefulness.
NCC 45	Volume 2 Section H Class 1 and 10 buildings – Fire safety H3P2 In a Class 1 building, occupants must be provided with automatic warning on the detection of smoke with an	Performance	Incorporates risk-based performance criteria but uncertain on usefulness

ID	Requirement	Type	Comments on the gaps
	efficacy greater than 0.95 and a reliability greater than 0.95, so that they may evacuate in the event of a fire to a place of safety appropriate to the— (a) function and use of the building; and (b) occupant characteristics; and (c) fire load and combustion characteristics; and (d) potential fire intensity; and (e) fire hazard.		
NCC 46	Volume 2 Section H Class 1 and 10 buildings – Fire safety H7O1 The Objective is to— (c) safeguard the occupants from illness or injury caused by fire from heating appliances installed within the building; and (d) safeguard the occupants from illness or injury in alpine areas from an emergency while evacuating the building; and (e) protect a building from the effects of a bushfire; and (f) reduce the likelihood of fatalities arising from occupants of a Class 1a dwelling not evacuating a property prior to exposure from a bushfire event.	Objective	Specific to residential buildings.
NCC 47	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7F2 Heating appliances A heating appliance using controlled combustion located in a building is to be installed in a way which reduces the likelihood of— (a) fire spreading beyond the appliance; and (b) smoke from the appliance entering the building.	Functional requirement	Contains a requirement for smoke re-entering a building. G4.3.4 contains a generic requirement for re-entry of contaminated air but not this specific.
NCC 48	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7F3 Alpine areas A building in an alpine area is to be provided with additional measures in view of the increased difficulties in fighting fire and maintaining access and means of egress in snow conditions.	Functional requirement	No special considerations in the NZBC for housing in alpine regions or local weather except for thermal comfort/wind loadings.
NCC 49	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7F4 Bushfire areas A Class 1 building or a Class 10a building or deck associated with a Class 1 building constructed in a designated bushfire prone area is to provide resistance to bushfires in order to reduce the danger to life and reduce the risk of the loss of the building.	Functional requirement	No special considerations in the NZBC for housing for local effects such as bushfire.
NCC 50	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7F5 Private bushfire shelters	Functional requirement	No special considerations in the NZBC for housing for

ID	Requirement	Type	Comments on the gaps
	A structure designed for emergency occupation during a bushfire event must provide shelter to occupants from direct and indirect actions of a bushfire.		local effects such as bushfire.
NCC 51	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7P3 Heating appliances A heating appliance and its associated components within a building, including an open fire-place, chimney, or the like, must be installed— (a) to withstand the temperatures likely to be generated by the appliance; and (b) so that it does not raise the temperature of any building element to a level that would adversely affect the element's physical or mechanical properties or function; and (c) so that hot products of combustion will not— (i) escape through the walls of the associated components; and (ii) discharge in a position that will cause fire to spread to nearby combustible materials or allow smoke to penetrate through nearby windows, ventilation inlets, or the like in the building containing the heating appliance.	Performance	Similar to C2.2 but more specific references to include chimneys, flues, chutes, etc. C2.2 does not include (a) and (c).
NCC 52	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7P4 Buildings in alpine areas (1) An external doorway from a building in an alpine area must be installed so that opening the door is not obstructed by snow or ice. (2) A building in an alpine area containing external trafficable structures forming part of the means of egress must be constructed so that they remain, as far as practicable, useable under snow conditions. (3) A building in an alpine area must be constructed so that snow or ice is not shed from the building onto the allotment, any adjoining allotment, road or public space in a location or manner that will— (a) obstruct a means of egress from any building to a road or open space; or (b) otherwise endanger people.	Performance	No special considerations in the NZBC for housing in alpine regions or local weather except for thermal comfort/wind loadings.
NCC 53	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7P5 Buildings in bushfire prone areas A Class 1 building or a Class 10a building or deck associated with a Class 1 building that is constructed in a designated bushfire prone area must be designed and constructed to— (a) reduce the risk of ignition from a design bushfire with an annual exceedance probability not more than 1:50 years; and	Performance	No special considerations in the NZBC for local effects such as bushfire.

ID	Requirement	Type	Comments on the gaps
	(b) take account of the assessed duration and intensity of the fire actions of the design bushfire; and (c) be designed to prevent internal ignition of the building and its contents; and (d) maintain the structural integrity of the building for the duration of the design bushfire.		
NCC 54	Volume 2 Section H Class 1 and 10 buildings – Ancillary provisions and additional construction requirements H7P6 A private bushfire shelter must be designed and constructed to provide a tenable environment for occupants during a design bushfire with an annual probability of exceedance not more than 1:200 years, appropriate to the— (a) location of the private bushfire shelter relative to fire hazards including— (i) predominant vegetation; and (ii) adjacent buildings and structures; and (iii) allotment boundaries; and (iv) other combustible materials; and (b) occupancy of the private bushfire shelter; and (c) bushfire intensity having regard for the bushfire attack level; and (d) fire intensity from adjacent buildings and structures, allotment boundaries and other combustible materials; and (e) ready access to the private bushfire shelter from the associated dwelling and occupant egress after the fire; and (f) tenability within the private bushfire shelter for the estimated maximum period of occupancy; and (g) generation of smoke, heat and toxic gases from materials used to construct the private bushfire shelter; and (h) structural and fire loads and actions to which it may reasonably be subjected, appropriate to— (i) the topography between the private bushfire shelter and the predominant vegetation or other fire hazards; and (ii) the distance between the private bushfire shelter and the predominant vegetation or other fire hazards; and (iii) the size of the potential fire source and fire intensity; and (iv) wind loading; and (v) potential impact from debris such as falling tree limbs; and (i) degree of external signage identifying the location of the private bushfire shelter; and (j) degree of internal signage identifying the design capacity and maximum period of occupancy; and	Performance	No special considerations in the NZBC for local effects such as bushfire.

ID	Requirement	Type	Comments on the gaps
	(k) degree of occupant awareness of outside environmental conditions; and (l) degree of essential maintenance.		
NCC 55	Volume 3 Plumbing Code section B Water services – Fire-fighting water services B4P2 Access and isolation (1) A fire-fighting water service must ensure access for maintenance of mechanical components and operational controls. (2) A fire-fighting water service must ensure the system can be isolated for testing and maintenance.	Performance	Limited requirements for fire fighting for housing in the NZBC. There are some aspects of water supply that are included in some district plans. Where required by the district plan, there is scope within the Building Code for how this is designed.
NCC 56	Volume 3 Plumbing Code section B Water services – Fire-fighting water services B4P3 Access and isolation Fire-fighting water storage Water storage supplying fire-fighting systems must be sized suitably for the level of risk and supply arrangements.	Performance	Limited requirements for fire fighting for housing in the NZBC. There are aspects of water supply that are regulated by the district plan but where required by the district plan, there is scope within the Building Code for how this is designed.
NCC 57	Volume 3 Plumbing Code section B Water services – Fire-fighting water services B4P4 Access and isolation Uncontrolled discharge A fire-fighting water service must avoid failure or uncontrolled discharge.	Performance	Limited requirements for fire fighting for housing in the NZBC. There are aspects of water supply that are regulated by the district plan but where required by the district plan, there is scope within the Building Code for how this is designed.

C.4 International Code Council I-codes

C.4.1 The ICC publishes prescriptive and performance based codes

The International Building Code (IBC) and International Residential Code (IRC) establish minimum requirements for building systems using prescriptive and performance-related requirements. The I-Codes are used in a variety of ways in both the public and private sectors. In communities in the US and in other countries, the I-Codes are used as the basis of laws and regulations.

While the IBC and IRC are prescriptive, they allow for performance-based design when the prescriptive requirements are difficult to apply due to either cost or out of scope building features. This is different from New Zealand which starts with the performance-based requirements and the prescriptive requirements are but one way to demonstrate compliance.

The ICC also publishes the ICC Performance Code (ICCPC). This code follows a similar framework as the New Zealand Building Code clauses with objectives, functional requirements, and performance criteria for each area of a building. The ICCPC does not directly link to the IBC and IRC prescriptive requirements.

C.4.2 Gaps in the New Zealand Building Code clauses for fire safety in comparison to the ICCPC

ID	Requirement	Type	Comments on the gaps
ICC 1	Pedestrian circulation – Means of egress 601.2 Enable occupants to exit the building, facility and premises or reach a safe place as appropriate to the design performance level determined in Chapter 3.	Functional requirement	Similar to C4.2 but C4.2 does not differentiate based on building type. Current means of escape requirements in the NZBC apply to all buildings similarly except those under 1000 people which are sprinklered. The requirement in the ICCPC applies differently for different performance groups and risk factors.
ICC 2	Pedestrian Circulation – Means of egress 601.3.1 General The construction, arrangement and number of means of egress, exits and safe places for buildings shall be appropriate to the travel distance, number of occupants, occupant characteristics, building height, and safety systems and features.	Functional requirement	These types of requirements were removed in 2012 from the NZBC.
ICC 3	Pedestrian Circulation – Means of egress 601.3.3 Unobstructed path Means of egress shall provide an unobstructed path of travel from each safe place to not less than one exit.	Performance	These types of requirements were removed in 2012.

Appendix C. Comparison to building codes from overseas

ID	Requirement	Type	Comments on the gaps
ICC 4	Pedestrian Circulation – Means of egress 601.3.5 Human biomechanics and expectation of consistency Means of egress shall enable reasonable use by the occupants in the building with due regard to human biomechanics and expectation of consistency.	Performance	
ICC 5	Pedestrian Circulation – Means of egress 601.3.9 Ease of use Means of egress shall be maintained and operated in such a manner to ensure that all egress facilities are readily openable and available without special knowledge or effort consistent with the use or occupancy characteristics.	Performance	These types of requirements were removed in 2012.
ICC 6	Safety of users – Construction and demolition hazards 703.2 Provisions are required during construction and demolition work to: 1.Protect authorized personnel from injury resulting from falling objects, fire, blasts, tripping or falling, or any other risk posed by the construction or demolition operation. 2.Prevent the entry of unauthorized personnel on the construction or demolition site. 3.Protect property off site from damage resulting from falling objects, fire, blasts or any other risk posed by the construction or demolition operations.	Functional requirement	Similar to F5.2. However, F5 does not include fire or blasts in the list of hazards.
ICC 7	Safety of users – Construction and demolition hazards 703.3.2 Protection from natural hazards. The structure under construction shall be protected from damage due to wind, rain or other natural hazards likely to occur during construction.	Performance	Nothing in F5 relates to natural hazards
ICC 8	Safety of users – Emergency notification 705.1 To provide notification of the need to take some manual action to preserve the safety of occupants or to limit property damage.	Objective	F7 contains measures for warning but only to preserve life safety of occupants and not to limit property damage.
ICC 9	Safety of users – Emergency notification 705.2.2 Emergency responder notification. Where systems are designed to notify emergency responders, such systems shall indicate the type of emergency and the location of the building. Where buildings are large enough to expect difficulty in prompt location of the fire or other public emergency, identification of the fire zone of origin shall be provided at the building	Functional requirement	Similar to C5.1 but C5.1 not about notifying the fire fighters just not delaying them.
ICC 10	Safety of users – Emergency notification 705.3.1 Type of notification	Performance	Similar to F7.3.2 and F7.3.3. However, F7.3.1 doesn't talk

ID	Requirement	Type	Comments on the gaps
	Notification of occupants shall be by means appropriate to the needs of the occupants, the use of the building and the emergency egress strategy employed.		about the egress strategy for the building. Linkages to the types of evacuation or evacuation schemes could be provided for in F7.
ICC 11	Safety of users – Emergency notification 705.3.2 Sleeping occupants Where required by the anticipated use of the building, notification systems shall be capable of alerting sleeping occupants in reasonable time to enable them to reach a safe place before the occurrence of untenable conditions at any point along the primary egress path.	Performance	Similar to F7.3.2 and F7.3.3. However, F7.3.2 only talks about household units and not all sleeping occupancies. The gap is around other sleeping accommodations.
ICC 12	Mechanical – Refrigeration 1002.1 To provide the safe installation and operation of refrigeration equipment.	Objective	Not specifically addressed for refrigeration but G10 includes cold, flammable, and toxic fluids.
ICC 13	Mechanical – Refrigeration 1002.2 The installation of equipment shall safeguard maintenance personnel and building occupants from injury.	Functional requirement	Not specifically addressed in the NZBC
ICC 14	Mechanical – Refrigeration 1002.3.4 Toxic and flammable refrigerants Refrigeration equipment shall have appropriate safeguards where utilizing toxic or flammable refrigeration agents.	Performance	Not specifically addressed in the NZBC
ICC 15	Electricity 1301.3.8 Essential services and equipment Essential services and equipment shall have a power supply protected in a manner to ensure continued operation for an appropriate time after a power failure.	Performance	This is not specifically addressed in the NZBC regulations. Gaps for fire safety would reflect to some specific systems but the gap is broader than just fire.
ICC 16	Fire prevention 1501.1 To limit or control the likelihood that a fire will start because of the design, operation or maintenance of a facility or its systems so as to minimize impacts on people, property, processes and the environment.	Objective	The objectives in C1 assume that fire has occurred and does not discuss preventing or limiting ignitions. Clause G9 Electricity is the only objective that

ID	Requirement	Type	Comments on the gaps
			talks about the outbreak of fire.
ICC 17	Fire prevention 1501.3.1 Ignition sources Electrical, mechanical and chemical systems or processes and facility services capable of supplying sufficient heat under normal operating conditions or anticipated failure modes to ignite combustible system components, facility elements or nearby materials shall be designed, operated, managed and maintained to prevent the occurrence of fire.	Performance	This is similar to C2.2 but includes some additional helpful wording about the devices that could cause a fire.
ICC 18	Fire impact management 1502.1 To provide an acceptable level of fire safety performance when facilities are subjected to fires occurring in the fire loads that may be present in the facility during construction or alteration and throughout the intended life.	Objective	The objectives do not consider construction or alteration. It also specifies that fire loads must consider the expected for the life of the building.
ICC 19	Fire impact management 1502.2 Buildings shall be designed with safeguards against the spread of fire so that persons not directly adjacent to or involved in the ignition of a fire shall not suffer serious injury or death from a fire and so that the magnitude of the property losses are limited as follows: Performance Group I—High Performance Group II—Moderate Performance Group III—Mild Performance Group IV—Mild	Functional requirement	C3.9 is similar to this but not formulated in a way that indicates different buildings should have different outcomes. The fire requirements need to reflect different outcomes for different performance groups.
ICC 20	Fire impact management 1502.2.5 Wildland fires. In wildland interface areas, facilities and vegetation shall be designed, constructed, arranged and maintained in such a manner to limit the impact to the building and the facilities during a wildland fire event.	Functional requirement	The design of buildings across wildfire is not present in the New Zealand Building Code. Control of vegetation is likely outside the scope of the Building Code.
ICC 21	Fire impact management 1502.2.6 Emergency responder needs. Facilities shall be arranged, constructed, maintained and operated with appropriate safeguards in place to perform their duties during an emergency event.	Functional requirement	This is similar to NZBC clause C5.1. However, the ICCPC 2024 wording is more broad and states "to perform their duties" rather than specific about rescue operations or firefighting which recognises other

ID	Requirement	Type	Comments on the gaps
			response may be needed for different emergencies.
ICC 22	Fire impact management 1502.2.8 Capability of building or facility users. Facilities open to persons of varying physical and mental capabilities shall provide reasonably equivalent levels of fire safety protection for those persons to the levels it provides for persons without disabilities.	Functional requirement	There is no difference in the NZBC for fire safety for different types of people.
ICC 23	Fire impact management 1502.3.1 Interior surface finishes. Interior surface finishes on walls, floors, ceilings and suspended building elements shall resist the spread of fire and limit the generation of unacceptable levels of toxic gases, smoke and heat appropriate to the design performance level and associated hazards, risks and fire safety systems or features installed.	Performance	Similar to C3.4 but includes toxic gases as a by-product. C3.4 only focuses on heat and smoke.
ICC 24	Fire impact management 1502.3.2 Limit quantities, configurations and combustibility of building materials, processes and contents so that fire growth and size can be controlled.	Performance	There are no limits on combustibles in a building design in the NZBC. This could be reworded into a functional requirement or objective.
ICC 25	Fire impact management 1502.3.3 Where necessary, provide appropriate measures to limit fire and smoke spread and damage to acceptable levels so that fire fighters are not unduly hindered in suppression or rescue operations.	Performance	C3 has limited performance criteria related to firefighting and C3.1, C3.2, and C3.3 do not contain functional requirements for firefighting.
ICC 26	Fire impact management 1502.3.5 Activation of detection systems. Fire detection systems, where provided, shall activate at a fire size appropriate to the fire and life safety strategies selected.	Performance	No explicit reference in F7 to how warning systems should or when they should activate.
ICC 27	Fire impact management 1502.3.6 Activation of suppression systems. Automatic fire suppression systems, where provided as a means of controlling fire growth or to suppress the fire, shall deliver sufficient suppression agent to control or suppress the fire as appropriate.	Performance	No requirements for suppression anywhere in the NZBC.

Appendix C. Comparison to building codes from overseas

ID	Requirement	Type	Comments on the gaps
ICC 28	Fire impact management 1502.3.7 Control of smoke. Smoke control systems, where provided, shall limit the unacceptable spread of smoke to nonfire areas as appropriate.	Performance	No requirements for smoke control systems anywhere in the NZBC.
ICC 29	Fire impact management 1502.3.8 Concealed spaces. Construction in concealed spaces shall inhibit the unseen spread of fire and unacceptable movement of hot gases and smoke, appropriate to associated hazards, risks and fire safety systems or features installed.	Performance	No requirements for concealed spaces.
ICC 30	Fire impact management 1502.3.9 Vertical openings. Vertical openings shall be constructed, arranged, limited or protected to limit fire and smoke spread as appropriate to the fire and life-safety strategies selected.	Performance	No requirements for vertical openings.
ICC 31	Fire impact management 1502.3.10 Wall, floor, roof and ceiling assemblies. Wall, floor, roof and ceiling assemblies forming compartments including their associated openings shall limit the spread of fire appropriate to the associated hazards, risks and fire-safety systems or features installed.	Performance	No requirement for roof or ceiling assemblies. This was an issue in the International Convention Centre fire in Auckland which result in excessive fire spread and difficulties in the firefighting response.
ICC 32	Fire impact management 1502.3.11 Structural members and assemblies. Structural members and assemblies shall have a fire resistance appropriate to their function, the fire load, the predicted fire intensity and duration, the fire hazard, the height and use of the building, the proximity to other properties or structures, and any fire protection features.	Performance	This is similar to C6.2 but explicitly includes the height of the building as a factor.
ICC 33	Fire impact management 1502.3.12 Exterior wall and roof assemblies' restriction of fire spread. Construction of exterior wall and roof assemblies shall restrict the spread of fire to or from adjacent buildings and from exterior fire sources, appropriate to the associated hazards, risks and fire safety systems or features installed.	Performance	No requirements for assemblies.
ICC 34	Fire impact management 1502.3.13 Exterior wall and roof assemblies' contribution to fire growth. Construction of exterior wall and roof assemblies shall resist the spread of fire by limiting their contribution to	Performance	No requirements for assemblies.

ID	Requirement	Type	Comments on the gaps
	fire growth and development, appropriate to the associated hazards, risks and fire safety systems or features installed."		
ICC 35	Fire impact management 1502.3.14 Air handling and mechanical ventilation systems. Air handling and mechanical ventilation systems, where provided, shall be designed to avoid or limit the unacceptable spread of fire and smoke to nonfire areas as appropriate.	Performance	No requirement for air handling.
ICC 36	Fire impact management 1502.3.15 Magnitude of fire event. Design fire events shall realistically reflect the ignition, growth and spread potential of fires and fire effluents that could occur in the fire load that may be present in the facility by its design and operational controls.	Performance	No specification of design fire events in the NZBC.
ICC 37	Fire impact management 1502.3.15.1 Design fire events. Magnitudes of design fire events shall be described in terms of the potential spread of fire and fire effluents given the proposed design, arrangement, construction, furnishing and use of a building.	Performance	No specification of design fire events in the NZBC.
ICC 38	Fire impact management 1502.3.15.2 Range of fire sizes. Magnitudes of design fire events shall be defined as small, medium, large and very large, based on the quantification of the design fire event as a function of the building use and associated performance group.	Performance	No specification of design fire events in the NZBC.
ICC 39	Fire impact management 1502.3.15.3 Engineering analyses of potential fire scenarios. Quantification of the magnitudes of design fire events shall be based on engineering analyses of potential fire scenarios that can be expected to impact a building through its intended life. For each design fire scenario considered, the analyses shall include the ignitability of the first item, the peak heat release rate of the item first ignited, the rate of heat release and expected fire growth, and the overall fuel load, geometry, and ventilation of the space and adjoining spaces.	Performance	No specification of design fire events in the NZBC.
ICC 40	Fire impact management 1502.3.15.3.1 Relationship of design fire to tolerable damage. When determining (assigning) the magnitude of a design fire event, the physical properties of the fire and its effluents shall only be considered in terms of how they impact the levels of tolerable damage. The magnitude of	Performance	No specification of design fire events in the NZBC.

ID	Requirement	Type	Comments on the gaps
	the fire event is not required to be characterized solely on the basis of the physical size of the fire in terms of its heat release and smoke production rates.		
ICC 41	Fire impact management 1502.3.15.3.2 Design parameters. Multiple design fire scenarios, ranging from small to very large design fire events, shall be considered to ensure that associated levels of tolerable damage are not exceeded as appropriate to the performance group.	Performance	No specification of design fire events in the NZBC.
ICC 42	Fire impact management 1502.3.15.3.3 Factors in determining design fire scenarios. The development of design fire scenarios shall consider the use of the room of fire origin and adjoining spaces, in terms of impact on occupant, property and community welfare.	Performance	No specification of design fire events in the NZBC.
ICC 43	Fire impact management 1502.3.15.3.4 Justification. Justification of the magnitudes of design fire events and design fire scenarios shall be part of the analysis prepared by the registered design professional and shall take into consideration the reasonableness, frequency and severity of the design fire event and design fire scenarios.	Performance	No specification of design fire events in the NZBC.
ICC 44	Fire impact management 1502.3.15.3.5 Design fires and fire scenarios shall be chosen to provide appropriate factors of safety to provide adequate performance by accounting for the following factors: 1.Effects of uncertainties arising from construction activities. 2.Variations in the properties of materials and the characteristics of the site. 3.Accuracy limitations inherent in the methods used to predict the fire safety of the building. 4.Variations in the conditions of facilities, systems, contents and occupants.	Performance	No specification of design fire events in the NZBC. This part about uncertainty kind of exists for structure in B1.3.4.
ICC 45	Emergency access and facilities 1701.3.2 Protrusions and appurtenances from structures Protrusions and appurtenances from structures shall not impede access, including vertical access, to the height of fire department aerial apparatus.	Performance	Not explicitly stated.
ICC 46	Emergency access and facilities 1701.3.4 Hose length limitations Access to structures shall afford the fire department the ability to deploy and operate hose lines without the need to extend the standard hose line utilized by the fire department having jurisdiction.	Performance	Not explicitly stated but used in the AS and VMs.

ID	Requirement	Type	Comments on the gaps
ICC 47	Emergency access and facilities 1701.3.5 Control valve locations Within structures, means for the deployment and operation of hose lines by emergency responders shall be provided such that control valves for lines shall be no further from potential fire sources than the length of hose packs employed by a single engine company of the fire department having jurisdiction.	Performance	Not explicitly stated.
ICC 48	Emergency access and facilities 1701.3.6 Water supply Water supply for fire department operations shall be from a reliable, readily accessible source acceptable to the fire department and capable of supporting fire-fighting operations.	Performance	May be outside the scope of the NZBC and would require consideration of interaction with district plans.
ICC 49	Emergency access and facilities 1701.3.9 Interaction of access and means of egress Exterior and interior egress and emergency access shall be arranged and maintained so that building occupants and emergency responders are unimpeded as each accomplishes its objectives of egress of occupants and access by emergency responders.	Performance	No provision exists to address occupant egress and firefighting response at the same time. This was a problem in the world trade center and would be an issue for other high rises. The gap is in C5.6.
ICC 50	Emergency access and facilities 1701.3.10 Interior and exterior staging Where necessary to ensure timely and effective emergency operations, interior or exterior areas shall be provided for the staging of equipment and apparatus.	Performance	This is a problem currently seen in the hydrant standard where designers don't want to provide appropriate staging areas. The gap is in C5.6
ICC 51	Emergency access and facilities 1701.3.11 On-site equipment Where necessary to ensure timely and effective emergency operations, fire-fighting equipment or other equipment to support such operations shall be provided and maintained readily available for use by emergency responders.	Performance	Hand-held firefighting (extinguishers) or hose reels not currently provided in the AS or VMs.
ICC 52	Emergency responder safety 1801.2 As appropriate to the design performance level determined in Chapter 3, the following shall be provided: 1.Information to responders regarding hazards present at the building or premises. 2.Protection against unanticipated structural collapse. 3.Appropriate fire service communications capability.	Functional requirement	While covered by C5, C5 does not include means for fire service communications capability.

ID	Requirement	Type	Comments on the gaps
ICC 53	Emergency responder safety 1801.3.4 Communication systems Communication systems for use by the emergency responders must be provided where the size, construction or complexity of the building cause the emergency responders' communication methods to be ineffective or unreliable.	Performance	Communication systems for firefighters not covered by the NZBC.
ICC 54	Hazardous materials 1901.1 To protect people and property from the consequences of unauthorized discharge, fires or explosions involving hazardous materials.	Objective	Covered by Hazardous substances regulations but questions remain on whether these features should be referenced in the Building Code.
ICC 55	Hazardous materials 1901.2.1 Prevention Provide adequate safeguards to minimize the risk of unwanted releases, fires or explosions involving hazardous materials as appropriate to the design performance level determined in Chapter 3.	Functional requirement	F3.2 does not contain specific requirements to prevent an incident and only discusses providing protection measures if a release occurs. The performance criteria do not separate requirements out for different building types (performance groups)

C.5 National Fire Protection Association NFPA 101®

C.5.1 NFPA standards are used throughout the world

The National Fire Protection Association (NFPA) publishes fire protection standards. They are based in the USA. Each jurisdiction within the US may choose to adopt an NFPA standard (or library of standards) or adopts different regulations or develop their own. Countries outside the US may also choose to adopt any of the NFPA standards if they deem them appropriate.

NFPA 101® Life safety code® is one of the most influential modern codes for fire safety. It is used broadly around the world and has influenced code development in other countries including New Zealand. NFPA 101 largely contains prescriptive provisions but also provides a framework for performance-based designs.

C.6 National Building Code of Canada 2020

C.6.1 Canada has an objective-based model code

The National Building Code of Canada (NBCC) is a model code. Provincial and territorial governments have the authority to enact legislation that regulates building design and construction within their jurisdictions. This may involve the adoption of the NBCC as a model code, either without change or with modifications to suit local needs.

The NBCC consists of 3 divisions:

- Division A contains the objectives and functional requirements of the code.
- Division B contains acceptable solutions which satisfy the objectives and functional requirements.
- Division C contains administrative provisions.

The acceptable solutions in the NBCC form the basis for assessing alternative solutions.

Alternative solutions must demonstrate that they comply as well as the acceptable solution provisions. Each provision in the acceptable solutions is linked to one or more objectives, functional requirements and intent statements which provides more information on the expected level of performance that must be achieved to satisfy the code.

C.6.2 There are gaps in the New Zealand Building Code clauses for fire safety in comparison to the NBCC

ID	Requirement	Type	Comments on the gaps
NBCC 1	OS1.4 An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to fire. The risks of injury due to fire addressed in this Code are those caused by— fire safety systems failing to function as expected	Objective	This is not area that is well address by the NZBC. There are some similar requirements in C3.9, C4.5, and C5.8 but they aren't explicit as this.
NBCC 2	OS1.5 An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to fire. The risks of injury due to fire addressed in this Code are those caused by— persons being delayed in or impeded from moving to a safe place during a fire emergency	Objective	Covered by C4 but C4 does not cover all emergency and only covers fires. The note on OS3.7 makes this clear that this is for all emergencies.
NBCC 3	OS3.5 An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to hazards addressed in this Code are those caused by— exposure to high levels of sound from fire alarm systems	Objective	Exposure to high levels of sound is not covered by F7. This can affect the abilities of the blind or people with other sensory sensitivities. Excessive sound is also disorienting for general populations.
NBCC 4	OS3.7 An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to hazards addressed in this Code are those caused by— persons being delayed in or impeded from moving to a safe place during an emergency (see Note A-2.2.1.1.(1)) A-2.2.1.1.(1) The term “emergency”—in the context of safety in buildings—is often equated to the term “fire emergency;” however, the wording of objectives OS3.7	Objective	This ties to OS1.5. It is covered by C4 but C4 does not cover all emergency and only covers fires. The note on OS3.7 makes this clear that this is for all emergencies.

ID	Requirement	Type	Comments on the gaps
	and OS5.9 makes it clear that the Code addresses any type of emergency that would require the rapid evacuation of the building, such as a bomb threat or the presence of intruders.		
NBCC 5	OS5 An objective of this Code is to limit the probability that, as a result of the construction or demolition of the building, the public adjacent to a construction or demolition site will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to construction and demolition hazards addressed in this Code are those caused by—persons being delayed in or impeded from moving to a safe place during an emergency	Objective	F5 does not cover emergencies.
NBCC 6	F06 To retard the effects of fire on facilities for notification, suppression and emergency response.	Functional requirement	There are no specific requirements in C5 to protect firefighting facilities. C5.6 only states that protection of their means of egress is required.
NBCC 7	F13 To notify emergency responders, in a timely manner, of the need to take action in an emergency.	Functional requirement	No requirements in F7 to notify responders even though there are requirements in C3 that assume firefighters show up.
NBCC 8	F31 To minimize the risk of injury to persons as a result of contact with hot surfaces or substances.	Functional requirement	This does not exists in the NZBC for fire requirements. This relates to temperature limits for fire rated components such as doors and windows.
NBCC 9	F34 To limit the level of sound of a fire alarm system	Functional requirement	Relates to OS3.5
NBCC 10	F36 To minimize the risk that persons will be trapped in confined spaces.	Functional requirement	C4 does not consider areas where people may be trapped. The NBCC applies this functional requirements to things like emergency power for elevators. There can be issues where people get

ID	Requirement	Type	Comments on the gaps
			trapped in high rises.[52]
NBCC 11	F41 To minimize the risk of generation of contaminants.	Functional requirement	Relates to a form of fire prevention and preventing toxic or noxious gases which may affect means of escape. The NBCC applies this functional requirement to things like laundry and waste chutes.
NBCC 12	F43 To minimize the risk of release of hazardous substances.	Functional requirement	Relates to a form of fire prevention
NBCC 13	F44 To limit the spread of hazardous substances beyond their point of release.	Functional requirement	Relates to a form of fire prevention and limiting fire spread (ie. containing potential fuels to their source)
NBCC 14	F81 To minimize the risk of malfunction, interference, damage, tampering, lack of use or misuse.	Functional requirement	Relates to a form of fire prevention and ensuring systems are functioning.

C.7 United Kingdom Building Regulations 2010

C.7.1 UK regulations are supported by approved documents

The UK Building Regulations 2010 contain mandatory provisions for buildings. This is similar to the New Zealand building regulations and Building Code clauses. The UK Approved Documents give practical guidance to comply with the UK Building Regulations 2010.

Approved documents set out what, in ordinary circumstances, may be accepted as reasonable provision for compliance with the relevant requirements of the Building Regulations to which they refer. As with the New Zealand acceptable solutions and verification methods, there is no obligation to adopt any particular solution contained in an approved document.

Following the Approved Documents does not always guarantee compliance with the Building Regulations. They are issued as guidance for common building situations and may not be appropriate for non-standard conditions such as unusual occupancies or high levels of complexity, or where some modern construction methods are used.

C.7.2 Gaps in the New Zealand Building Code clauses for fire safety in comparison to the UK building regulations

ID	Requirement	Type	Comments on the gaps
BR 1	B2. Internal fire spread (linings) B2(1)(b) To inhibit the spread of fire within the building,	Functional requirement	This is similar to requirements in C3

[52] https://www.nzherald.co.nz/nz/no-power-no-water-auckland-waterfront-apartment-tower-residents-left-without-services/BPXJZQ6TFJBQJH6WKVQC5SMW5A/#:~:text=Water%20leaking%20into%20the%20power,due%20to%20a%20power%20outage

ID	Requirement	Type	Comments on the gaps
	have, if ignited, either a rate of heat release or rate of fire growth which is reasonable in the circumstances.	(approximate)	but considers the consequences if they do ignite and explicitly states that it is both the heat release rate and fire growth rates which are important.
BR 2	B3. Internal fire spread (structure) (2) A wall common to two or more buildings shall be designed and constructed so that it adequately resists the spread of fire between those buildings. For the purposes of this sub-paragraph a house in a terrace and a semi-detached house are each to be treated as a separate building.	Functional requirement (approximate)	This has an explicit requirement for fire spread between party walls. This is not addressed in C3.
BR 3	B3. Internal fire spread (structure) (3) Where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken, to an extent appropriate to the size and intended use of the building, comprising either or both of the following— (a) sub-division of the building with fire-resisting construction; (b) installation of suitable automatic fire suppression systems.	Functional requirement (approximate)	This considers limiting fire spread through separations or fire suppression which is not specified in the NZBC.
BR 4	B4. External fire spread (1) The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.	Functional requirement (approximate)	External fire spread discusses the height and use of the building which is not considered in the NZBC.
BR 5	B4. External fire spread (2) The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.	Functional requirement (approximate)	Fire spread over roofs not stated in the NZBC.

C.8 World Bank Building Code Checklist for fire safety

C.8.1 The checklist provides a framework to review provisions of building and fire regulations

The Building Code Checklist for Fire Safety assists with conducting detailed reviews of the fire safety provisions of building and fire regulations. It provides a robust approach to reviewing fire safety provisions. It does not form a regulatory framework itself but allows for discussion of the fundamental fire safety components that may or may not be present in a regulatory system.

C.8.2 Gaps in the New Zealand Building Code clauses for fire safety in comparison to the World Bank Checklist

ID	Topic	Comments on the gaps
WB 1	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.2 Fire resistance of non-load-bearing structural components	There is no specific requirements in the

ID	Topic	Comments on the gaps
	2.2.1 Fire resistance of walls, ceilings, floors, shafts, and roof The fire resistance of interior fire rated compartment barriers is a very important issue for fire safety. The objectives of this measure are to prevent fire spreading in large areas, spaces connecting several floors, such as stairs, shafts, and void spaces, and so forth. Compartmentation is necessary to control fire spread, facilitate safe evacuation, and so forth.	NZBC for compartmentation. There is also no requirement for fire rated roofs.
WB 2	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.2 Fire resistance of non-load-bearing structural components 2.2.2 Fire resistance of openings (or closures) in interior fire-rated barriers (for example, door systems, windows, dampers, access panels, ducts, etc.) Also, hot gases will flow through corridors, shafts, and other such spaces, so dampers, self closing doors, and similar features are needed.	There is no specific requirements in the NZBC for fire resistance of non-load bearing structural members. C6 applies to load bearing members.
WB 3	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.2 Fire resistance of non-load-bearing structural components 2.2.3 Fire resistance of exterior wall systems/façade systems The fire resistance of exterior wall systems is important to help control for fire external to a building from entering the building. It can also be important to control for exterior wall systems contributing to the fuel load and to fire spread (see also 2.3–2.6 below). Note that for some building uses and sizes, separation distance between buildings/lot lines can be a mitigation measure.	There is no specific requirements in the NZBC for fire resistance of non-load bearing external wall or façade systems. This includes curtain walls or other types.
WB 4	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.2 Fire resistance of non-load-bearing structural components 2.2.4 Fire resistance of roof systems The fire resistance of roof structures can be important for structural stability and control of fire spread.	There is no requirement for fire rated roofs in the NZBC.
WB 5	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.6 Building/lot separation & exterior fires 2.6.3 Separation between buildings and exterior sources of exposure (for example, trash bins, trees, shrubs, vehicles, etc.) There is a wide range of sources of potential exterior fires, which if located near the exterior wall of a building could lead to ignition of fire in the building. Exterior sources of potential exposure include trash bins, stored materials, vegetation, vehicles, transformers, etc.	No requirements to consider the exterior sources of exposure in the NZBC. Some of this may be regulated through district plans but is not directly addressed by the NZBC. A specific concern may be to transformers or other electrical infrastructure (including battery storage).
WB 6	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.1 Smoke resistance of interior smoke compartment barriers (for example, fire cells, shafts, etc.) Smoke is a major threat to building occupants in a fire. Due to pressure differentials in a building resulting from interior and exterior temperature differences, smoke can be pushed through cracks and	No specific requirements in the NZBC for smoke spread through compartmentation or other barriers. C3 has no specific controls around smoke spread (this is partially covered in a

ID	Topic	Comments on the gaps
	other small openings, which should be fire and smoke sealed. See also 2.2 above.	round-about way contingent on meeting requirements in C4-C6).
WB 7	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.2 Smoke resistance of openings in interior smoke barriers (for example, door systems, dampers, ducts, etc.) See 2.7.1. Also, smoke will flow through corridors, shafts, and other such spaces, so dampers, selfclosing doors, and similar features are needed to inhibit smoke flow. See also 2.2 above, as fire and smoke resistance for interior spaces can sometimes be addressed together.	No specific requirements in the NZBC for smoke spread through compartmentation or other barriers. C3 has no specific controls around smoke spread (this is partially covered in a round-about way contingent on meeting requirements in C4-C6).
WB 8	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.3 Passive smoke and heat venting components/ systems Some building uses, such as storage and factory, or atrium spaces in tall buildings may benefit from rooflevel vents that exhaust smoke and hot gases, allowing occupants to escape and fire service to conduct suppression operations. Passive vents typically are activated by a fusible link, but in some cases may be activated in conjunction with the operation of the fire alarm.	No requirements for passive smoke venting. C3.8 contains some measures for large buildings that may result in smoke venting in a roundabout way.
WB 9	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.4 Tenability criteria (smoke layer, temperature, CO, etc.) Smoke and other products of combustion cause most fire fatalities. Providing pathways clear of smoke for occupants to escape is essential (see 3.3). It can be helpful to have smoke exhaust systems in many buildings; this is a common feature in large buildings and high-rise atria buildings. The design of smoke exhaust systems is often aimed at maintaining tenable environments for people while they evacuate (or fire service while undertaking operations). Tenability criteria may be smoke level above floor, temperature of smoke layer, or concentration of gases/toxicants.	No specific requirements for smoke exhaust/smoke control systems (this is partially covered in a round-about way contingent on meeting requirements in C4-C6).
WB 10	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.5 Design fire requirements Design of smoke exhaust systems generally requires an assumption about the fire that is expected and mass of smoke that may be produced. Some jurisdictions include design fire specification in their regulations.	No specific criteria in the NZBC for how a fire should be specified or what needs to be considered. C/VM2 contains some parameters but these do not apply to alternative solutions.
WB 11	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.6 Mechanical smoke and heat exhaust – exhaust rates/make-up air Exhaust rates/volumes will depend on the expected fire and mass of smoke produced. Also, there must be enough fresh air coming in to	No specific requirements in the NZBC on what to consider for smoke control.

ID	Topic	Comments on the gaps
	facilitate proper operation of exhaust fans. Some jurisdictions provide calculation methods to guide these designs.	
WB 12	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.7 Pressure differentials Fires increase temperature, which can result in pressure differentials, which in turn push smoke into cracks and openings. In addition to sealing openings, creating pressure differentials can help impede smoke movement. In some cases, this can include providing barriers between spaces (in this case, pressure differentials may be considered to keep a corridor clear of smoke, for example). Pressure differentials across doors can also make it more difficult for occupants to open the door.	No specific requirements in the NZBC on what to consider for smoke control.
WB 13	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.8 Stack effect Stack effect is movement of air into and out of buildings through unsealed openings as a result of differentials between indoor-to-outdoor air density resulting from temperature and moisture differences. From a fire perspective, this can cause smoke to stratify and be pushed onto floors (think of smoke rising from a chimney in cold temperatures) or be pushed higher (less temperature differential to overcome). Either situation can impact evacuation in unconditioned stairs and create other challenges.	No specific requirements in the NZBC on what to consider for smoke control.
WB 14	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.9 Sprinkler interaction Smoke rises due to the high temperatures produced from a fire. This is why smoke vents and exhaust ports are most often located at ceiling/roof level. Sprinklers cool smoke and fire. In cases where smoke vents/exhaust and sprinklers are used, care must be taken to design appropriately to the interactions.	No specific requirements in the NZBC on what to consider for smoke control.
WB 15	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.10 Operation (automatic, manual, both – sequence) In some jurisdictions, the fire service requires full control over smoke exhaust systems, while in others it is possible to have automatic systems with manual override. It can be helpful to define what is permitted and how the system should operate.	No specific requirements in the NZBC on what to consider for smoke control or for fire fighting
WB 16	2. RESISTANCE TO FIRE/SPREAD OF FIRE 2.7 Smoke control/management 2.7.11 Smoke exhaust controls The fire service will generally require control over smoke exhaust systems. As such, it can be important to identify the location and controls required for smoke exhaust systems.	No specific requirements in the NZBC on what to consider for smoke control or for fire fighting requirements.
WB 17	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.2 Occupant and fire service notification 3.2.3 Alarm notification devices (visible) FASs require installation of alarm notification devices to alert occupants. Visible alarm notification devices may include flashing or	While F7 covers warning systems, there are no specific requirements in the NZBC for visible notification devices

ID	Topic	Comments on the gaps
	strobe lights. Requirements may include location and intensity (candela). Visible notification devices are required to meet disability requirements.	including when they are required or to what level of performance.
WB 18	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.2 Occupant and fire service notification 3.2.4 Emergency voice communication system In high occupancy buildings, highrise buildings, and other such complex or high-risk building, many jurisdictions require emergency voice communications to control evacuation. This allows building management or the fire service to direct evacuation appropriate to the event.	There are no requirements for emergency voice communication systems.
WB 19	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.2 Occupant and fire service notification 3.2.5 Emergency voice communication control panel (EVCCP) Where emergency voice communication systems are required to control evacuation, there needs to be an EVCCP located in a readily accessible and protected space, typically on the ground level, to facilitate building management or the fire service to direct evacuations appropriate to the event.	There are no specific requirements in the NZBC for emergency voice communication systems for fire service use.
WB 20	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.3 Protected means of escape/refuge 3.3.1 Exit protection Occupants should be protected from fire events during the time required to egress a building. Jurisdictions often require FRR for exits (including corridors, stair shafts, and doors) to provide such protection.	There are no specific requirements for the protection of occupants in exits (this is partially covered in a round-about way contingent on meeting requirements in C4 and through the definition of place of safety).
WB 21	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.3 Protected means of escape/refuge 3.3.2 Refuge areas/ horizontal exits Occupants should be protected from fire events during the time required to egress a building. For those occupants unable to exit on their own, due to disability, infirmity, or other reasons, areas of refuge inside of the building may be required. Jurisdictions often require FRR for refuge areas to provide such protection. Horizontal exits are often required in hospitals. Communication systems are often also required.	There are no specific requirements for the protection of occupants in exits (this is partially covered in a round-about way contingent on meeting requirements in C4 and through the definition of place of safety). There is no requirement for a communication system to a place of refuge/place of safety.
WB 22	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.3 Protected means of escape/refuge 3.3.3 Refuge floors In very tall buildings, the time required to evacuate by stairs can be quite long and tiring for occupants. To provide safe interruption of egress and time to rest, some jurisdictions require that intervals of	There is no requirement for refuge floors in the NZBC for tall buildings.

ID	Topic	Comments on the gaps
	refuge floors (no occupancy – just open area, with sprinkler protection and other features) be provided	
WB 23	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.4 Occupant load, travel distance, and exit capacity 3.4.3 Exit numbers (including minimum required) It is generally impractical to assume all occupants can exit via a single path/stair/door. Many jurisdictions require a minimum of two exits from all but very small buildings, and at least two exits from each floor of high-rise buildings, with the total number of exits increasing as occupant load increases.	There is no requirement for the number of exits in the NZBC though C/AS2 contains requirements. C4.5 contains some non-specific criteria to consider.
WB 24	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.4 Occupant load, travel distance, and exit capacity 3.4.4 Exit locations It is generally inappropriate to have all occupants enter exits at a single location and discharge to the outside at a single location, in case one exit becomes compromised. Determining the location of exits is a function of travel distance to an exit and remoteness of exit access and discharge.	There is no requirement for the number of exits/exit locations though C/AS2 contains requirements in the NZBC. C4.5 contains some non-specific criteria to consider.
WB 25	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.4 Occupant load, travel distance, and exit capacity 3.4.5 Exit remoteness Exit remoteness is a measure of distance between exit access points in a building (or floor of a building in high-rises). It is often required that exit access points be located no closer than 1/3-1/2 the diagonal dimension of the floorplate. This is to facilitate having one exit access available in case another is compromised.	There is no requirement for the number of exits/exit remoteness in the NZBC though C/AS2 contains requirements. C4.5 contains some non-specific criteria to consider.
WB 26	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.4 Occupant load, travel distance, and exit capacity 3.4.6 Exit discharge Exits should generally discharge to the exterior into a public way or suitably protected courtyard. This pathway to the exterior is the exit discharge. These may include corridors and exit discharge doors.	There is no requirement for the exit discharge in the NZBC though C/AS2 contains requirements. C4.5 contains some non-specific criteria to consider.
WB 27	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.4 Occupant load, travel distance, and exit capacity 3.4.8 Dead-end travel limits Finding an exit in an emergency can be difficult, and it is important that occupants avoid walking into spaces from which they cannot exit (dead end). Many jurisdictions therefore limit the length of dead-end corridors (for example, to 5 m or 7 m).	There is no requirement for dead-end travel limits in the NZBC though C/AS2 contains requirements. C4.5 contains some non-specific criteria to consider.
WB 28	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.5 Occupant/occupancy characteristics (vulnerabilities) 3.5.1 Occupancy/ use groups Different building uses and occupant characteristics present different risks and hazards and therefore require different levels of protection	The NZBC has classifications for occupancies in A1 and A3. However, there is limited application of these in C1-C6.
WB 29	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.5 Occupant/occupancy characteristics (vulnerabilities) 3.5.2 Accessible exit components	D1 contains requirements for access into buildings but there

ID	Topic	Comments on the gaps
	To the extent practicable, exits should be designed for people of all abilities. Accordingly, components in means of egress, such as doors, should meet accessibility requirements. Note that some jurisdictions do not require all exits to be accessible.	is limited consideration for the useability of exits.
WB 30	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.5 Occupant/occupancy characteristics (vulnerabilities) 3.5.3 Refuge areas/ horizontal exits Occupants should be protected from fire events during the time required to egress a building. For those occupants unable to exit on their own, due to disability, infirmity, or other reasons, areas of refuge inside of the building may be required. Jurisdictions often require FRR for refuge areas to provide such protection. Horizontal exits are often required in hospitals. Communication systems are often also required.	There are limited requirements for areas of refuge. There are some measures in the definition of "place of safety" but no statement of when this is to be provided.
WB 31	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.5 Occupant/occupancy characteristics (vulnerabilities) 3.5.4 Occupant self-evacuation lifts In very tall buildings, the time required to evacuate by stairs can be quite long and tiring for occupants. To address this concern, some jurisdictions allow occupant self evacuation lifts.	No provisions for self evacuation lifts in the NZBC.
WB 32	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.6 Safety glazing, protection against falls, etc. 3.6.1 Safety glazing Glazing that is used within circulation spaces of a building, in particular means of escape, should provide protection to occupants against breakage, and as appropriate, be fire rated.	No requirements for fire rating of safety glazing. F4 contains provisions for barriers.
WB 33	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.6 Safety glazing, protection against falls, etc. 3.6.4 Door swing in exit pathway, exit hardware, locks The inability for escaping occupants to exit buildings due to door swing or revolving doors has contributed to many large life-loss events. As such, most jurisdictions require exit doors to open in the direction of the path of exit travel. Also, exit doors should be unlocked from the inside, and where they need to be unlocked, should do so automatically on alarm. Pushbar (emergency) hardware should be used where practicable in places of assembly and other large occupant load buildings.	No requirements in the NZBC for exit components at this level of detail including when pushbar hardware should be used.
WB 34	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.6 Safety glazing, protection against falls, etc. 3.6.5 Door swing exit discharge For the reasons outlined above, where practicable, exit doors that discharge to public ways should open in the direction of exit travel (that is, out to the street). The exit discharge door should also be protected from parked cars and other obstructions. This may require bollards.	No requirements in the NZBC for exit components or discharge of exits.
WB 35	3. OCCUPANT SAFETY, REFUGE, AND EGRESS 3.7 Signage, lighting, and emergency power 3.7.4 Wayfinding guidance In addition to exit signage and pathway illumination, it may be helpful to have message boards or other wayfinding guidance in very large buildings, such as transit terminals, sports arenas, and the like.	No requirements in the NZBC for wayfinding.

ID	Topic	Comments on the gaps
WB 36	4. FIRE SUPPRESSION 4.1 Extinguishers 4.1.1 Handheld fire extinguishers Handheld fire extinguishers can serve as a means for early intervention to suppress a fire. Regulations can identify what type of fire extinguisher is appropriate for which hazards in a building and where they should be located.	No requirements in the NZBC for extinguishers.
WB 37	4. FIRE SUPPRESSION 4.2 Water supply 4.2.3 Fire service connections For some large, complex buildings, including high-rise, large storage, and large public spaces with interior hydrant (standpipe) systems, there may be a need for connections to firefighting apparatus to provide water.	No requirements in the NZBC for fire service connections.
WB 38	4. FIRE SUPPRESSION 4.2 Water supply 4.2.5 Fire pump(s) Depending on the local situation with municipal (or local stored) water supply for firefighting and on the size of the building, fire pumps may be needed to provide the necessary pressure and flow rates for sprinklers and manual suppression.	No requirements in the NZBC for fire pumps.
WB 39	4. FIRE SUPPRESSION 4.3 Manual suppression 4.3.1 Exterior fire service hydrants Fire hydrants are essential for connecting firefighting apparatus to water supplies. There are typically external hydrant systems connected to water mains and internal to the building for firefighter use.	No requirements in the NZBC for exterior hydrants.
WB 40	4. FIRE SUPPRESSION 4.3 Manual suppression 4.3.2 Fire service interior hydrants (standpipes) Interior hydrants (standpipes) are essential for providing firefighting water throughout large and tall buildings. This allows firefighters to connect hoses locally within the building, near the fire, without laying long distances of hose.	No requirements in the NZBC for interior hydrants.
WB 41	4. FIRE SUPPRESSION 4.3 Manual suppression 4.3.3 Fire service connections In some countries, hose reels for fire service use are required. However, other countries have dropped this requirement due to the fire service's preference for bringing their own hoses to connect to interior hydrants. Where provided, regulations can identify where they should be located, hose length, and related parameters.	No requirements in the NZBC for fire service connections.
WB 42	4. FIRE SUPPRESSION 4.3 Manual suppression 4.3.4 Manual fire suppression water capacity (flow and pressure) It is necessary to understand water capacity, flow, and pressure needs for the interior fire service hydrant (standpipe), along with sprinkler systems requirements, to design overall firefighting water supply systems for the building.	No requirements in the NZBC for flow and pressure of water.

ID	Topic	Comments on the gaps
WB 43	4. FIRE SUPPRESSION 4.3 Manual suppression 4.3.5 Occupant-use hose reels In some countries, occupant use hose reels are used for early intervention to suppress a fire. However, other countries have dropped this due to potential risk to user (if not successful in controlling fire). Where provided, regulations can identify where they should be located, hose length, and related parameters.	No requirements in the NZBC for occupant-use hose reels.
WB 44	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.1 Automatic sprinkler system Automatic fire sprinklers are among the most effective way to control fires when small and to keep them small, limiting impacts to life and property. Most jurisdictions require a full building automatic fire sprinkler system to be installed in all high occupancy buildings, high-rise buildings (residential, commercial, institutional), hospitals, and other such complex or high-risk buildings. Some jurisdictions require sprinklers for storage, industrial, and most other occupancies as well. Some jurisdictions require all buildings except 1-2 family dwellings to be sprinklered.	No requirements for automatic sprinkler systems in the NZBC.
WB 45	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.2 Sprinkler design density/ hazard classifications Design of automatic fire sprinklers depends on the expected fire loads. Different regulatory approaches are used, such as light hazard or ordinary hazard, to define design parameters. The building regulation may define different categories for different building uses (for example, office may be light hazard).	Sprinkler hazards defined in the standards and not in the NZBC.
WB 46	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.3 Sprinkler design area Sprinkler systems are typically designed by considering hydraulically remote design areas in which a specified number of sprinklers may be activated. This is necessary to understand water capacity, flow, and pressure needs.	Sprinkler design area defined in the standards and not in the NZBC.
WB 47	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.4 Sprinkler water capacity, flow, and pressure It is necessary to understand water capacity, flow, and pressure needs for sprinkler systems, along with interior fire service hydrant (standpipe) requirements, to design firefighting water supply systems for the building.	Sprinkler flow and pressure defined in the standards and not in the NZBC.
WB 48	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.5 Water flow alarm (local) Sprinkler heads are a form of heat detection, so when the sprinkler activates, it should sound a local water flow alarm—typically located on the outside of a building—to signal to people that water is flowing.	Water flow alarms are not specified in F7.
WB 49	4. FIRE SUPPRESSION 4.4 Automatic suppression	Water flow alarms are not specified in F7.

ID	Topic	Comments on the gaps
	4.4.6 Water flow (connection to FACP) Sprinkler heads are a form of heat detection, so when the sprinkler activates, it should sound an interior alarm via the FACP, to signal to occupants that there is a fire. This is important because smoke detectors and other such devices may not be installed in sprinklered buildings, so flow alarms are the primary alarm initiating devices.	
WB 50	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.7 Sprinkler supervision Supervision of fire sprinkler systems is important to monitor positions of valves.	Monitoring of systems not required in the NZBC.
WB 51	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.8 Special extinguishing systems Some spaces in certain buildings may require suppression systems that do not use water (for example, chemical systems for commercial stove/oven exhaust systems, inert gas in computer space).	Special systems not required in the NZBC.
WB 52	4. FIRE SUPPRESSION 4.4 Automatic suppression 4.4.9 Automatic extinguishing system supervision Any installed special extinguishing system should be supervised by the building FACP to indicate alarms and notify responsible persons if there is a problem with the system.	Supervision of the automatic extinguishing system not specified in F7.
WB 53	5. FIRE SERVICE ACCESS AND FACILITIES 5.1 Access for fire apparatus and equipment Access for fire apparatus is critical, yet usually not included in building regulations. Rather, attributes such as roadway width, turning radius, and access to buildings is often found in planning regulations. This needs to be coordinated. Access should not be over underground parking.	There are aspects of access to front/primary entrances that are within the scope of the Building Code. No requirement to limit access over underground parking.
WB 54	5. FIRE SERVICE ACCESS AND FACILITIES 5.2 Access to stairs, hydrants, and hose reels The fire service should have clear access within buildings, especially to locations of FACPs and emergency command centers (ECCs). It should also be easy for them to readily identify stairways and firefighter lifts for operational and occupant evacuation needs.	No requirements for FACPs and ECCs in the NZBC so no requirements for access.
WB 55	5. FIRE SERVICE ACCESS AND FACILITIES 5.3 Firefighter lifts All high-rise buildings present challenges for the fire service, from bringing equipment to upper floors, to evacuating impaired or disabled persons. As such, many jurisdictions require either dedicated firefighter lifts or controls that allow firefighters to take control of lifts in emergencies.	No specific requirements for FF lifts in the NZBC.
WB 56	5. FIRE SERVICE ACCESS AND FACILITIES 5.4 Firefighter communications and command center In high occupancy buildings, highrise buildings, and other such complex or high-risk building, many jurisdictions require a dedicated ECC (fire command center) for use by the fire service to direct evacuation communication, control lifts, control smoke exhaust, and	No requirement for ECC in the NZBC.

ID	Topic	Comments on the gaps
	similar functions. Such ECCs are typically protected by fire-rated construction. The ECC would house the FACP/ EVCCP and other similar controls.	
WB 57	A1. USE/OCCUPANCY CLASSES A1.1 While not a fire safety principle/strategy, for building regulation, this sets benchmark criteria for specific fire safety requirements (based on population of building, size of building, primary activity of building, etc.) In general, building use/ classification depends on the climate, geography, cultural background, etc. of a country. An important point is that building-use classes in the building regulations should reflect the building uses of the country in question. Specific to fire safety, different building uses and occupant characteristics present different risks and hazards and therefore require different levels of protection. This should be considered.	No specific requirements for climate, geography, cultural background, etc. Traditional Maori structures are not well defined or considered.
WB 58	A1. USE/OCCUPANCY CLASSES A1.2 Special provisions for mixed-use occupancy buildings When a building contains multiple uses (for example, high-rise residential on top of commercial or retail space), care should be taken to identify what provisions apply to the building and/or its parts (for example, most restrictive for the use applies or mix based on uses).	There are no additional requirements for mixed use occupancies.
WB 59	A1. USE/OCCUPANCY CLASSES A1.3 Special provisions for high-rise buildings High-rise buildings are characterized by long times for occupant evacuation and fire service response. They may also have large populations. The consequences of a fire are generally higher (in particular structural failure). These factors often warrant additional requirements (for example, higher fire resistance requirements, automatic sprinklers, voice communications) over low-rise buildings of the same use.	There are no additional requirements for high-rise buildings.
WB 60	A1. USE/OCCUPANCY CLASSES A1.4 Special provisions for atria Depending on area, height, and openness to floors above grade, this may impact fire and smoke control, suppression system, and egress. As such, additional requirements or guidance may be warranted.	There are no additional requirements in the NZBC for atria or additional requirements for these buildings.
WB 61	A1. USE/OCCUPANCY CLASSES A1.5 Underground structures Underground structures, especially with large numbers of people (for example, malls), also require special provisions because they are characterized by high density of occupants, limited (upward) evacuation, smoke exhaust challenges, and darkness if electrical outage occurs.	There are no additional requirements in the NZBC for the height or location of structures above/below ground.
WB 62	A2. COORDINATION ISSUES A2.1 Fire stability of structure with structural provisions Fire resistance of structural systems may be found in association with building use/ occupancy classes or under fire protection (which may be part of the mechanical or building services), but may also be found under structure, in particular where reference codes such as the Eurocode for Structures are used. Coordination with structural is critical.	Coordination between fire and B1 structure requires further consideration.

ID	Topic	Comments on the gaps
WB 63	A2. COORDINATION ISSUES A2.2 Alternate methods of design Many building regulations allow for the use of alternate design methods (engineered design/ performance-based design). It is important to check that this is coordinated across areas.	No additional requirements in the NZBC when considering alternate design methods.
WB 64	A2. COORDINATION ISSUES A2.3 Seismic bracing of fire protection systems In seismic zones, it can be important to have seismic bracing of non-structural systems and components, including fire protection systems. Coordination with structural design is important to understand if and when seismic bracing is needed for fire protection systems, and if so, how best to address it in the building regulation.	No requirements in the NZBC linking seismic bracing for fire protection systems.
WB 65	A2. COORDINATION ISSUES A2.4 Coordination with mechanical, electrical, and plumbing provisions on smoke and electrical Requirements for smoke exhaust systems may be found in the fire protection section of the regulations. However, they might also be found under the mechanical or building services section. Also, sprinklers and manual fire protection systems may be designed by mechanical or plumbing engineers. Coordination with mechanical engineers for these systems is very important when reviewing regulations.	Limited coordination in the NZBC between and other building services.
WB 66	A2. COORDINATION ISSUES A2.5 Coordination with vertical transport on elevator recall and/or firefighter lifts /and/or occupant self-evacuation lifts In cases where firefighter lifts and/ or occupant self-evacuation lifts are used, coordination with vertical transportation requirements is important.	No requirements in the NZBC linking clause D2 and fire provisions.
WB 67	A2. COORDINATION ISSUES A2.6 Coordination with accessibility on accessible components in egress system most egress systems will have at least some accessible features. Coordination with accessibility requirements in the regulations is important.	Limited coordination in the NZBC between fire and accessible egress.
WB 68	A2. COORDINATION ISSUES A2.7 Coordination with façade/external wall/ envelope on insulation, fire spread, etc External wall/façade systems can be very complex, and sometimes use materials such as insulation, which may be combustible. Fire performance of materials in façade and insulation systems should be coordinated with energy performance/mechanical.	Limited coordination in the NZBC between fire and façade or insulation requirements.
WB 69	A4. OTHER LEGISLATION/REGULATIONS A4.1 Electricity infrastructure/distribution system/building power supply requirements (primary) Electricity is one of the most common sources of fire ignition. Inadequate electricity infrastructure leading to buildings can create ignition hazards. This can be a particular concern in informal settlements and construction. Also, unreliable electricity can significantly impact safety systems. Understanding and coordinating with electricity infrastructure is critical.	Limited consideration in the NZBC for electricity infrastructure. Specific concern would be proximity to overhead lines, substations, transformers.

ID	Topic	Comments on the gaps
WB 70	A4. OTHER LEGISLATION/REGULATIONS A4.2 Emergency power supply requirements Emergency power requirements for fire safety systems need to be coordinated with overall building emergency power needs.	Limited requirements in the NZBC for emergency power.
WB 71	A4. OTHER LEGISLATION/REGULATIONS A4.6 Land management/ wildfire exposure requirements In many countries, urban environments are merging with the wildland, and with climate change increasing temperatures and extending droughts, fires at the wildland urban interface are increasing. Some jurisdictions have created special codes or standards to address particular needs in the wildland-urban interface. These, and fire suppression, need to be coordinated.	Wildfire not considered in the NZBC.

Appendix D. Identified building code issues

D.1 Issues across multiple New Zealand Building code topics

D.1.1 Issues compiled from a variety of sources

This appendix contains a combined list of issues in the fire safety issues identified from:

- meetings with stakeholders
- previous fire events and reviews of the Building Code
- comparisons to buildings codes and standards used internationally

The combined total includes over 170 issues identified from these sources. These issues have been grouped together into common problems and listed by the level of impact and complexity.

D.1.2 The issues are organised by topic

The issues in this appendix are organised by the topics shown in Figure 11. The first two topics relate to the objectives of the building code and residential buildings, as these affect the largest number of people. If you are unfamiliar with the technical details of fire safety or construction, we suggest you focus on these topics but encourage you to read the other sections of this document as well.

Fire safety requires consideration of the building as a whole including the hazards and occupants present, the fire safety features provided, and the response available by firefighters. As such, the issues identified in some topics overlap with issues in other topics.

Appendix D. Identified building code issues

Figure 11. The fire safety topics in buildings discussed in this document

D.1.3 Significant issues with gaps in the New Zealand Building Code

The most significant issues identified:

- are created by gaps that are not adequately addressed by the Building Code regulatory system; or
- were those frequently raised in conversations with external stakeholders as items to be resolved.

Other significant issues identified:

- limit the flexibility of the fire safety provisions; or
- are complex items across multiple parts of the Building Code or overlap with other legislation or regulations; or
- created by confusion or uncertainty amongst users of the Building Code's mandatory regulations.

The other important issues identified are:

- incompatibilities between Building Code requirements and the associated verification methods and acceptable solutions; or
- technical items are only contained in the acceptable solutions and verification methods; or
- only some may impact certain building types or building features but may not be issues for all buildings.

Additionally, there are a number of longstanding drafting and minor technical wording issues in the Building Code and the acceptable solutions and verification methods documents that need to be corrected. These items are not presented in this document.

MBIE logs and records all feedback provided to us. It is expected that these minor issues would be reviewed where possible in future consultations. After that, updates would be made to the acceptable solutions and verification methods documents.

D.2 Objectives of the Building Code

The objectives of the Building Code outline what we are trying to achieve from our buildings as a country. They form a bridge between the Building Act to the Building Code requirements. Each part of the Building Code covers a separate topic. It is important to make sure the objectives are correct. The items included in the objectives are key for establishing all other requirements in the Building Code.

D.2.1 Damage to buildings caused by fire

Protecting other property from the damage caused by fire is an objective in the Building Code. In the past, this focused mainly on stopping fires spreading between buildings. It was more common for fire to spread between multiple buildings in dense urban environments. Historically, city-wide fires in Auckland and Christchurch burned through large blocks of buildings as firefighters struggled to contain the blazes[53]. The response to these fires were restrictions around the construction of buildings to ensure that if a fire occurred, it would be limited in its impact and more manageable by firefighters.

While the New Zealand Building Code focuses on protecting other property but not own's own property, other overseas building codes focus on the protection of the building and property where the fire starts[54]. Protecting the building can mean that fires are more manageable as they are less likely to spread between multiple buildings on the same site and less likely to spread where there are buildings with multiple owners (such as multi-unit residential buildings or office towers). This can make it easier for firefighters to do their jobs so they can also help limit the damage caused by the fire. This can also mean that there is less risk of a structural collapse of a building which is important when buildings are close together.

Fires in heritage buildings[55], medical offices[56] and government buildings[57] in New Zealand could affect how we go about our daily lives. Buildings that have higher importance to society including hospitals, large public buildings, infrastructure, and others that need to continue functioning post-disaster may not be usable if a major fire were to occur within them.

There are no specific objectives in the Building Code that require additional protection for societally important buildings. In 2007, it was recommended that the Building Code consider refocusing objectives on public well-being to address some of these gaps in the Building Code[58].

We have identified the lack of protection of the building as an issue in the fire safety objectives.

Issue 2-1. Protection of the building
The objectives in clause C1 do not apply to the protection of the building or one's own property and only state that protection of 'other' property is required. This has several implications:

- Fires may spread between separate buildings under common ownership. This can increase the overall size of the fire and damaged caused by the fire. This may also increase the challenges to firefighters responding to a fire. There is an expectation that FENZ will respond and firefighting may occur to help limit the damage to property. The less protection provided for the building, the greater the risk there is to firefighters.

[53] Refer to Appendix B.1 and historical fire events in Auckland and Christchurch in HFE 2, 3, 4, 5.
[54] Refer to Appendix C for comparisons to other international buildings codes.
[55] Refer to Appendix B.1 and historical fire event HFE 79 – 2019 – Municipal Building – Whangarei.
[56] Refer to Appendix B.1 and historical fire event HFE 60 – 2011 – FENZ Heads up article 10.
[57] Refer to Appendix B.1 and historical fire events HFE 1, 5 and 8.
[58] Refer to Appendix B.2 and report R007.

- Fire may spread between the floors of a multi-storey building. Fires on the exterior of a building (such as cladding fires) can spread vertically over multiple floors and eventually threaten other buildings putting occupants and firefighters at risk.
- There may be limited consideration for the structural collapse of a building in a fire. Structural collapse of a building due to fire would endanger those in the building, near or adjacent to the building, and in other buildings. Structural performance affects the entire building regardless of property boundaries. Protection of a building versus the property versus other property would have significantly different outcomes for the structural design.
- Buildings that have higher importance to society including hospitals, large public buildings, infrastructure, and others that need to continue functioning post-disaster. But they may not be usable if a fire were to occur within them as there are no specific objectives in the Building Code that require these buildings to be protected or the damage caused by fire to be limited.
- There may be a loss of amenity to the building or other owners in a multi-unit building as fires generally impact the whole building. Other provisions for safety (such as B1 Structure) contain provisions to prevent a loss of amenity.
- Some objectives create an inconsistency with the performance criteria for external walls close to a property boundary. Clause C3.7 and the acceptable solutions and verification methods place additional requirements on external walls close to a boundary. This includes limits on ignitability of the materials and can include fire ratings from 2 directions (external fire sources and internal fire sources). These provisions and the methodology for external fire spread across property boundaries appear to require a minimum level of protection for the owner's building. But there is no specific objective that addresses this.
- It is often difficult to define what constitutes other property to be protected. Buildings may be sub-divided, re-combined, or changed in ownership without triggering building consent or change of use applications. This can cause confusion on how specific requirements are intended to apply in a building and lead to delays in consenting and approvals.

References to other Building Codes: NCC 1**,** NBCC 2**,** NBCC 4
References to issues identified by stakeholders: SRG 1**,** SRG 5**,** SRG 8**,** STM 7**,** STM 9**,** STM 19**,** STM 21**,** STF 12**,** STF 15**.**

D.2.2 Emergencies other than fires

Earthquakes, flooding, and wildfire events or other instances where there may be emergency declarations may require evacuation from buildings[59]. Gas leaks and fires involving hazardous substances create serious hazards, such as the cold store explosion in Tamahere in 2008 which left one firefighter dead and seven more injured[60]. Evacuation and firefighter rescue can be difficult from many buildings if there is a power outage and lifts cannot be used.[61]

It was previously recommended in 2007 that the New Zealand Building Code contain provisions for means of escape for these other emergencies[62] and we have identified this as an issue in the review.

Issue 2-2. Fire and other emergencies
The objectives in Building Code clause C1 address fire but there are no additional considerations for other emergencies. There are other emergencies that would require the evacuation and emergency access into a building such as gas leaks, medical emergencies, intruders in a building, flooding, cyclones, weather events, or loss of power.

[59] Refer to Appendix B.1 and historical fire events 111 to 114.
[60] Refer to Appendix B.1 and historical fire event HFE 69.
[61] It was reported that residents of an apartment building in Auckland had difficulty leaving their units due to a power outage. See: The New Zealand Herald (2024-06-04), "No power, no water: Auckland waterfront apartment tower residents left without services". Accessed online from: https://www.nzherald.co.nz/nz/no-power-no-water-auckland-waterfront-apartment-tower-residents-left-without-services/BPXJZQ6TFJBQJH6WKVQC5SMW5A/#:~:text=Water%20leaking%20into%20the%20power,due%20to%20a%20power%20outage
[62] Refer to Appendix B.2 and report R008.

This has implications for clause C4 Movement of people to safety and C5 Access and safety for firefighting operations as these only cover fire emergencies.
References to other Building Codes: NBCC 2, NBCC 4
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 8

D.2.3 Building features for firefighting

It is important to recognise that firefighters require access to buildings and features in buildings to do their jobs. With that in mind, we have identified that the role of firefighting in the Building Code is unclear which makes it uncertain what facilities are to be provided.

Issue 2-3. Role of firefighting
The objectives in C1 do not consider that firefighting may help preserve life or limit property damage. There are no objectives that would require firefighting facilities to be provided to help prevent injuries, save lives, limit the spread of fire, or limit property damage. These are other functions that firefighters may have reasonable expectations to perform. The role of firefighting and its impact on the fire safety of the building is uncertain in the New Zealand Building Code.
References to issues identified by stakeholders: NCC 16, ICC 8

D.2.4 The surrounding environment

The negative impact that fires can have on the surrounding environment has been highlighted in several fires in New Zealand where toxic smoke, asbestos, hazardous chemicals and toxic water run-off have been released[63]. Prior to 2012, the Building Code clauses for fire safety contained an objective to safeguard the environment. Fires in buildings can spread to adjacent forests and trees, impact air quality, emit greenhouse gases, and run-off from firefighting water can contaminate ground water or other nearby water bodies. Both the Australian and the International Code Council building codes contain provisions to protect the environment[64].

Under the Fire and Emergency New Zealand Act, there are principal objectives that firefighters will protect and preserve life and limit injuries. But firefighters are also expected to limit the damage to property and land and prevent and limit damage to the environment. The less protection that is provided for the building to achieve these objectives, the greater the risk there is to firefighters when performing their duties.

Issue 2-4. Protection of the surrounding environment
The objectives in C1 do not consider protection of the surrounding environment. Fires in buildings can spread to adjacent forests and trees, impact air quality, emit greenhouse gases, and run-off from firefighting water can contaminate ground water or other nearby water bodies. Firefighting may involve measures to protect the environment. However, the less protection that is provided for the building, the greater the risk there is to firefighters.
References to other Building Codes: NCC 24**,** ICC 16
References to issues identified by stakeholders: SRG 1**,** SRG 5**,** SRG 8

D.2.5 Fire safety challenges throughout the life of a building

Fires can occur at all states of the life of a building including when it is under construction[65], when it changes in use[66], and when it is no longer occupied[67]. The Parliament buildings in Wellington suffered from fires during the refurbishment in 1991. Similarly, the 2019 fire at the International Convention Centre in Auckland also occurred during construction. During this fire, there were multiple challenges in firefighting including getting access to the building and internal fire hydrants. A fire in a large timber building under construction in Canada lead to a dramatic helicopter rescue of a crane operator who was trapped for 2 hours while the fire burned

[63] Refer to Appendix B.1 and historical fire events HFE 68, 69, 71, 76,
[64] Refer to Appendix C and items NCC 24 and ICC 16.
[65] Refer to Appendix B.1 and historical fire events HFE 8, 87, 92, 96, and 97.
[66] Refer to Appendix B.1 and historical fire events HFE 35, 39, 60, 63, and 89
[67] Refer to Appendix B.1 and historical fire events HFE 41, 64, 76, and 81.

below him. Loafers Lodge in Wellington was originally constructed as a school for nurses and underwent multiple changes in use before it was used as a boarding house. This fire raised questions on what level of fire safety should be provided as the use changes.

There are other provisions in the Building Code for the structural design of the building that require buildings to remain stable throughout the life of the building, including during construction and demolition. However, the Building Code fire safety provisions do not require that fire safety be considered throughout the lifespan of a building.

Issue 2-5. Lifespan of a building
The Building Code fire safety provisions do not require that safety be considered throughout the lifespan of a building. This includes fire safety risks in construction, use, inspection, maintenance and repair, alteration, when it stands unoccupied, or due for demolition. At the same time, there is no allowance made for safety margins, construction tolerances, ageing of the systems, or maintenance and operations of the systems.
References to issues identified by stakeholders: SRG 1, SRG 8

D.2.6 Clarity on what is unacceptable

Some of the language used in the objectives and other parts of the fire safety provisions are vague or unclear. Different people may have different opinions on what is acceptable or not and this may vary for different buildings. In 2007, it was recommended that the language in the Building Code should shift from avoiding risks to establishing safety goals[68] and we have identified this as an issue in the review.

Issue 2-6. Unacceptable risks and low probabilities
Code clause C1 (a) states that the objectives of C2 – C6 are to "safeguard people from an unacceptable risk of injury or illness caused by fire". There is no statement of what is considered an unacceptable risk. There are further instances throughout clauses C2 – C6 that set either functional or performance requirements with a "low probability of occurrence". There is no definition of a low probability. This can introduce uncertainty in design and consenting of buildings due to inconsistencies in the interpretation of these statements. There are different expectations for what is acceptable for different types of buildings when it applies to the protection of other property or buildings. For instance, it may be acceptable to lose a single storey building in a remote location in a fire but not be acceptable to have a high-rise building collapse in the middle of city.
References to issues identified by stakeholders: SRG 1**,** SRG 3**,** SRG 5**,** STM 21

D.2.7 We have identified two other important issues for the objectives of the Building Code

Issue 2-7. Purpose of warning systems
The objectives for F7 Warning Systems mentions only safeguards for people. It does not mention in its objective requirements to limit property damage or to notify the fire service.
Notifying building users and the fire service result in faster:

- evacuations
- fire service response, and
- the use of hand-held firefighting equipment to limit fire spread and damage.

References to issues identified by stakeholders: ICC 8, ICC 9

Issue 2-8. Preventing unwanted ignitions
The objectives in C1 do not clearly cover prevention of unwanted ignition. Clause G9 Electricity contains the only objective that relates to the prevention of the outbreak of fire. Preventing ignitions can increase the safety of buildings overall.
References to other Building Codes: ICC 16

[68] Refer to Appendix B.2 and report R007.

D.3 Residential fire safety

Fire safety is a crucial aspect of ensuring the protection of homes, families, whānau, and hapū. The Building Act highlights the importance of the household unit and the need to ensure that people can escape from a building if it is on fire. To help keep housing affordable, it is important that the fire safety provisions talk to other parts of the Building Code so that solutions work for all parts of the Building Code.

D.3.1 Most significant issues

Most injuries and deaths in New Zealand due to fire occur in residential homes with approximately 10 to 15 deaths per year and 1 to 2 fire deaths per event[69]. The number of fire deaths had declined in comparison to the 1990s. Adults (over 65 years of age), males, and Māori are overrepresented in the residential fire deaths. Other risk factors include those with disabilities, those who had consumed alcohol or drugs immediately before the fire, and those who were habitual smokers. These factors limit the ability of the occupants to leave the building if it is on fire or increase the risk of ignition of a fire.

Key measures to maintain fire safety in smaller residential buildings include smoke alarms in sleeping areas and bedrooms. Smoke alarms detect fires early giving people more time to evacuate. Smoke alarms can detect small smouldering fires that generate smoke before they become bigger fires. FENZ have reported on several fires where residential smoke alarms resulted in early notification of the fire and reduced the consequences of the fire[70]. Data from the United States also supports this and there are significantly better outcomes in residential fires where alarms are present[71]. Fire safety measures and smoke alarm requirements for existing residential tenancies are found outside of the Building Code in the Residential Tenancies Act 1986 and its smoke alarm regulations[72].

We have identified that residential buildings require specific fire safety considerations.

Issue 3-1. Residential specific requirements
There are limited specific considerations for the fire safety of residential buildings. Housing in the New Zealand Building Code are included alongside other buildings with limits on when certain features do not apply to housing.
Smaller residential buildings have their own unique challenges and fire problems such as types of construction, fire safety systems, evacuation, and firefighting response.
When preparing an alternative solution for residential buildings, the performance criteria that apply to all buildings can be difficult when the same criteria are applied to residential buildings and will generally result in building fire safety features that are more difficult to apply generally than the prescriptive acceptable solutions.
References to issues identified by stakeholders: SRG 1, SRG 8, SRG 10
References to other Building Codes: NCC 44, NCC 45, NCC 46, NCC 47, NCC 48, NCC 49, NCC 50, NCC 51, NCC 52, NCC 53, NCC 54, NCC 55, NCC 56, NCC 57, ICC 1, ICC 19, ICC 38, ICC 55

D.3.2 Boarding houses and hostels

Historically, fires in hotels, boarding houses, hostels, and care homes have often resulted in multiple fire deaths in a single event[73]. These buildings often had specific issues like a lack of proper exits, single stairwells that

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[69] Refer to Appendix B.1 and historical fire events HFE 9 for data on residential fire deaths
[70] Refer to Appendix B.1 and historical fire events HFE 37 and 38.
[71] McGree, T. (2024-06-01), "Smoke Alarms in US Home Fires", National Fire Protection Association. Available online from: https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/smoke-alarms-in-us-home-fires
[72] Refer to the Residential Tenancies (Smoke Alarms and Insulation) Regulations 2016
[73] Refer to Appendix B.1 and historical fire events HFE 7, 23, 25, 26, 27, 29, 30, 31, 38, 39, and 40 for instances of fires in hotels, boarding houses, and backpackers.

could be blocked by fire and smoke, a lack of smoke alarm or sprinkler systems, or occupants trapped or locked in rooms.

The Loafers Lodge fire in Wellington in 2023 is a recent example where multiple people have died in a single fire in a boarding house in New Zealand. There have been other deadly boarding house fires in New Zealand[74]. Some of these buildings tend to be older with less fire safety features and have more occupants at risk than other types of accommodation buildings. It was previously estimated that there was an 11 times greater risk of a fatality in transient accommodation in New Zealand than in other types of residential buildings.

Having fire suppression systems, such as fire extinguishers and sprinklers, can help put out small fires before they become uncontrollable. The benefits of sprinklers have been recognised in multiple fires in New Zealand and internationally. Where significant loss of life has occurred in fires, this has often led to sprinkler systems being required in higher risk buildings to prevent similar consequences in future events[75].

To comply with the acceptable solutions in the Building Code, taller buildings are required to be sprinklered in New Zealand where they are approximately 8 or 9 storeys tall[76]. Sprinklers are also required for education accommodation buildings regardless of the height of the building[77]. Sprinklers are not required for other residential buildings in the acceptable solutions. It means that other accommodation buildings such as apartments, hotels, motels, and boarding houses are not required to be protected with sprinklers until they reach 8 or 9 storeys in height regardless of how large a floor area they have or how many people are in the building.

We have identified the fire safety for at risk populations as an issue.

Issue 3-2. Accommodation buildings and at risk populations
Transient accommodation buildings and other residential buildings with at risk populations require further consideration to see what fire safety features are required.
Transient accommodation includes buildings such as hostels, backpackers, boarding houses, emergency housing, sleepouts, and recognised seasonable employee accommodations.
These buildings have specific fire safety challenges. Those requiring assistance in evacuation are exposed to higher risks as it may take longer to evacuate the building, and they may have to wait until the fire service responds to assist them. But features such as sprinklers or visual alerting devices on fire alarms for those who are deaf or hard of hearing are not generally provided in these buildings.
The existing MBIE guidance for residential community housing is not suitable for some of these buildings as the management and use of the buildings do not meet the provisions set out in the guide.
References to issues identified by stakeholders: SRG 5**,** STM 7**,** STM 10**,** STF 5**,** STF 16**,** STF 18**,** STF 19

D.3.3 The type of housing being constructed has changed

The types of homes we are building has changed over the past 10 years. New Zealand is building more and more multi-unit dwellings every year. This includes townhouses and apartment-style buildings. From 2013 to 2023, the percentage of stand-alone houses consented has decreased from 81% to 42%[78]. This means that

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[74] A study in 2014 provided a summary of boarding house fires from 1987 to 2007. This includes the 1992 fire at the Ferry Road Hostel where seven people died and the 1995 fire at the New Empire Hotel where six people died. Refer to Thomas, G. Harding, D. (2014), "Fire safety in New Zealand transient accommodation buildings", Building a Better New Zealand. Accessed online from: https://www.researchgate.net/publication/273123751_FIRE_SAFETY_IN_NEW_ZEALAND_TRANSIENT_ACCOMMODATION_BUILDINGS
[75] Refer to Appendix B.1 and historical fire events HFE 42 and 44 for New Zealand fires events resulting in sprinklers for hospitals and care homes. Refer to HFE 27, 29, 31, 47, HFE 48 for fire events in Australia, Canada, and United States.
[76] Refer to Acceptable Solution C/AS2 Amendment 3, 2 November 2023, Table 2.2 for escape heights above 25 metres.
[77] Refer to Acceptable Solution C/AS2 Amendment 3, 2 November 2023, Table 2.2, for Risk Group SM and education occupant type.
[78] Ministry of Business, Innovation and Employment (2024). "Building and Construction Sector Trends Annual Report 2023". Accessed online from: https://www.mbie.govt.nz/building-and-energy/building/building-system-insights-programme/sector-trends-reporting/building-and-construction-sector-trends-annual-report/2023

more than half of all new-consented homes are in multi-unit buildings and over the past decade that number has comparatively tripled.

Multi-unit dwellings and medium or high-density housing has it is own unique challenges. This can require considerations of the emergency egress from the buildings, the ways to limit spread, and how to protect the structure, and firefighting access[79]. Overseas, building codes have specific requirements for small residential buildings or separate building code sections.

Information from the last 10 years also shows there is an increase of fires spreading from buildings[80]. This means that a fire starting in your neighbour's house may then spread to your house, to other buildings, or to the surrounding bush. One way to limit fire spread in or from a building is through the use of fire-resisting materials in construction including walls, ceilings, and doors and limiting the paths that fire and smoke could spread in a building[81]. This can slow the spread of fire and provides more time for evacuation and more time for firefighters to respond to a fire once they are notified. Past reviews of the New Zealand Building Code have noted that the level of fire-resistance used in New Zealand is much lower than in other countries[82]. The building code in Canada was also revised in 2010 to include new measures for the construction of external walls and roof overhangs because of an increase in fires spreading between houses[83].

The Building Code also places limitations on what must be provided for firefighters to respond to residential homes which can limit the effectiveness of their response. Access to residential buildings for firefighters is getting more difficult where houses are remote from the street or accessed by narrow driveways. This can delay the efforts by firefighters and result in fires spreading to adjacent buildings[84]. We have identified aspects of modern housing construction as an issue.

Issue 3-3. Housing densification
The increase in the number of houses, housing densification, means an increased need to ensure medium and high-density housing is safe from fire.
New housing developments bring challenges to the new buildings, their designers, and occupants to ensure appropriate fire safety features are provided.
As well, existing houses may be exposed to an increased risk of fire spread from the new developments.
Specific concerns exist where:

- Buildings are close to boundaries or other buildings and limiting fire spread or structural collapse is important to prevent damage to other properties;
- Multi-unit buildings are not sprinklered and only have one means of escape;
- Fuel loads used in design do not reflect modern buildings' construction materials and furnishings;
- Buildings are tall and the structural elements have limited fire resistance; and
- Access to the buildings by fire fighters or other emergency services is difficult.

References to issues identified by stakeholders: **SRG 1, SRG 5, SRG 10, SRG 12, STF 16, STF 19**

D.3.4 Wildfires have destroyed homes in New Zealand for over a hundred years

There are records of wildfires destroying houses in New Zealand going back to 1872[85]. These occurred across the country from Invercargill and Otago to Taranaki and Whangarei. Hotter, drier and at times windy conditions in many areas of New Zealand increases the risk of wildfires. More recent fires in the Port Hills in Christchurch

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[79] Frank, K. "Fire safety for densified housing", BRANZ Build Magazine, Issue 180, October/November 2020
[80] Refer to Appendix B.1 and historical fire event HFE 14.
[81] Fire and Emergency have highlighted the benefits of fire separations between adjacent units to limit fire spread. Refer to Appendix B.1 and a comparison of outcomes between HFE 16 without intact fire separations and HFE 17 with intact fire separations.
[82] Wade, C. & Baker, B. (2022), "Densified Housing: Analysis of Fire Resistance Requirements", BRANZ external research Report ER69.
[83] Refer to Appendix B.1 and historical fire event 10.
[84] Fire and Emergency New Zealand provided information on a fire event where there was inadequate access for firetrucks and insufficient water supply by street hydrants. This prevented firefighters from quickly responding to a house fire and four houses were lost when fire spread from one building to the next. Refer to Appendix B.1 and historical fire event HFE 21.
[85] Refer to Appendix B.1 and historical fire events HFE 103 to HFE 114.

in 2017 and Lake Ōhau in 2020 have resulted in multiple houses being destroyed. On 4 October 2020, the wildfire in Lake Ōhau spread into the village and destroyed 48 homes. Without a change of building design or firefighting resources to address susceptibility from wildfires, potentially more homes will be lost in the future and we have identified this as an issue.

Issue 3-4. Wildfires in residential areas
There are no special considerations for the protection of residential buildings from wildfire and bushfire events. There is scope within the Building Code to provide measures for how buildings might be constructed at the wildland and urban or rural interface. Hotter, drier and at times windy conditions in many areas of New Zealand increases the risk of wildfires. Without a change of building design to address susceptibility from wildfires, potentially more homes could be lost in future due to wildfires. FENZ has produced a Wildfire Safer Housing guide to assist homeowners build in ways that reduces the risk of structure being lost in the event of a wildfire.
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 8

D.3.5 We have identified four other significant issues for residential fire safety

Issue 3-5. Classification of residential buildings
The building regulatory system contains multiple ways to define a building's use and these often overlap or leave gaps in the classification of residential buildings. It can be unclear where a building fits and what fire safety features are required. This can be even more complicated if a building undergoes a change in use. Examples include different types of transient accommodation or residential buildings with different levels of care provided.
References to issues identified by stakeholders: SRG 10, STM 7

Issue 3-6. Door locks
Acceptable Solution C/AS1 has no mention on the use of door locks in residential buildings, what is permitted or can be accepted. Door locks on individual sleeping units may prevent someone from being fashion and other considerations of fire safety may be necessary to make up for any delays. There are examples of housing being designed with separate toilet facilities and door locks in apartment-style rooms with only communal kitchen facilities. This falls between boarding houses and hostel use and needs additional consideration of what is appropriate for these buildings.
References to issues identified by stakeholders: STM 7, STF 5

Issue 3-7. Fuel loads in residential building
There are limited provisions in the New Zealand Building Code to:

- control the combustibles present or
- consider the design of the building for the expected fuel load.

Limiting the quantities or combustibility of materials can lower fire spread. The use of combustible insulation materials in modern homes may increase the expected fuel and fire growth rates previously considered for residential buildings.
Currently, there are limited requirements in the Building Code that regulate the types of insulation that can be used in residential buildings.
Prefabricated walls for residential buildings may be filled with combustible insulation. Older homes being altered may also use highly combustible plastic, polystyrene, or polyethylene insulation in their walls which can lead to rapid fire development in them.
At the same time, there are no requirements that limit the fire performance of roof cladding systems. This means that roof cavities with combustible insulation can carry very high fuel loads.
References to issues identified by stakeholders: STM 3

Issue 3-8. External safe paths
Residential buildings with external vertical safe paths require smoke lobbies to be included on ground floors if designed in accordance with Acceptable Solutions C/AS2. There are alternative solutions that exist to demonstrate these are not needed but these are not in the acceptable solution(s).

This increases the cost of compliance as computer fire modelling and engineering analysis is required to justify the designs.
References to issues identified by stakeholders: STF 15

D.3.6 We have identified five other important issues for residential fire safety

Issue 3-9. Issue 3-9. Warning systems for sleeping occupants
There are no specific considerations in the Building Code for fire events and the notification of sleeping occupants versus other types of occupants.
While F7.3.2 and F7.3.3 contain requirements for alerting and notification, but no consideration for sleeping occupants who require longer building evacuation times and earlier detection and alarm may be required.
References to other Building Codes: ICC 11

Issue 3-10. Evacuation schemes in multi-unit residential buildings
There are conflicts between the fire safety systems required in multi-unit residential buildings and the Fire and Emergency (Evacuation Scheme) Regulations 2018. In some cases, multi-unit residential buildings can be designed without fire alarms which means there would be no automated means to notify occupants of a fire in an adjacent unit.
References to issues identified by stakeholders: STF 15

Issue 3-11. Fire stopping to roof cladding
There are several requirements in the Acceptable Solutions C/AS1 and C/AS2 that require fire rated eaves, or walls to continue to the underside of the roof cladding. But there are no test methods to determine the:

- fire resistance rating of eave construction, or
- fire stopping construction of at the roof cladding to create a fire separation.

Additional considerations are required to determine how compliance with these requirements can be achieved.
References to issues identified by stakeholders: SRG 2, SRG 3

Issue 3-12. Soffits
Additional considerations are required for the protection of external soffits and eaves where there is an inter-tenancy wall. The requirements in C/AS1 Part 5 refer to relevant boundaries and walls angled less than 90 degrees from each other but are unclear how this applies in 3 dimensions with overhangs that straddle boundaries.
References to issues identified by stakeholders: STF 13

Issue 3-13. Schedule 1 exemptions
When used in conjunction with Building Act Schedule 1 exemptions, it is not clear whether the parameters of Schedule 1 can be modified for use with C/AS1 where C/AS1 is less difficult to apply than the Building Act. Schedule 1 buildings are typically their own height from the boundaries but there is an interpretation that C/AS1 permits these to be 1 m away from boundaries or other buildings.
References to issues identified by stakeholders: STF 5

D.4 Fire hazards and prevention

Fire hazards refer to the conditions or situations that cause fires to start or spread and what we are trying to protect against. Identifying and mitigating these hazards is crucial to prevent fires and ensure the safety of building occupants.

D.4.1 Fire hazards vary by the use of the building

The fire hazards in a building could be drastically different based on its use and design. Additionally, the consequences of a fire in one building may be more severe than in other buildings. Each type of building presents its own unique risks which may require different solutions to maintain safety in a building. This may start with the ways to prevent the fire from occurring and to reduce the damage caused by them.

While some requirements of the Building Code specify what the level of protection is required, there are no clear descriptions of what fire scenarios the building should be designed to. It is not clear what the buildings are to be protected from, or what impact is expected to be mitigated, or what to consider in the design. We have identified this as an issue in the fire safety provisions.

Issue 4-1. Hazards for different buildings
Different types of buildings have their own hazards that require varying levels of protection. While A1 and A3 define different categories of buildings, there are limited application of these to the requirements for C1-C6 in the Building Code. There are also no specific requirements for the use or classification of buildings. Specific concerns exist based on:

- Climate, geography, and cultural background of users which may require different levels of protection.
- Heritage buildings or traditional Māori construction that cannot comply easily with the Building Code and require waivers or modifications.
- Buildings containing a mix of uses where the most complex use may not necessarily apply for all parts of the building.
- The activities undertaken within some industrial buildings which may increase the risk of fire occurring.
- Taller buildings with higher occupant loads and increased requirements for fire spread, structural design, and fire service access. C3 Fire affecting areas beyond the fire source does not consider differences in fire spread risk except for multi-level buildings over 10 m in height.
- Atriums which may require additional fire safety features depending on their area, height, and openness.

References to other Building Codes: ICC 19, BR 4, WB 57, WB 58, WB 59, WB 60
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 8

D.4.2 Additional sources of ignition

Clause C2 of the Building Code contains measures for the prevention of fires. This clause only lists a limited number of appliances that could cause a fire. A previous review of the Building Code found that this clause did not appropriately address the hazards it was associated with[86].

While other clauses in the code provide measures for electrical or gas safety, there are no linkages to these clauses in C2 and it unclear how they are accounted for in the fire hazards to be assessed for a building. We have identified this as an issue in the Building Code.

Issue 4-2. Sources of ignition
Clause C2 has very little on the devices or appliances that could cause a fire. Additional sources of ignition that could be subject to fire prevention requirements include:

[86] Refer to Appendix C and report R019.

- electrical systems
- mechanical systems
- chemical systems, and
- processes that supply heat and could ignite combustible materials under normal operation or likely failure modes.

References to other Building Codes: ICC 17

D.4.3 New energy sources pose new fire challenges

Fires involving batteries (such as lithium-ion) are becoming more prevalent as these are becoming the power source for more and more devices, including cars. These batteries have very high energy densities and are subject to thermal runway so when they do catch fire, the effects can be severe. There have been instances in Wellington, Christchurch, and Auckland of e-scooter fires[87]:

- On 29 July 2023, the explosion of a battery in an apartment building Wellington sent one person to the hospital.
- On 27 February 2024, a townhouse in Christchurch was destroyed by fire when a charging e-scooter exploded. Occupants had to be rescued from a second story window.
- On 22 August 2024, an apartment building in Auckland had to be evacuated because of an e-scooter fire.

Solar panels can also present challenges. A warehouse in Hamilton had solar panels on the roof and a fire in 2022 melted the cables to the electrical isolation switches[88]. These hazards represent new fire challenges that test the current robustness of fire designs. However, the Building Code is not flexible enough to address these or other new hazards (only home heating appliances are addressed) and we have identified this as an issue.

Issue 4-3. Green technologies and emerging risks
Green technologies in residential and commercial buildings present new fire challenges that test current fire designs. These include:

- electric vehicles
- solar panels, and
- small and medium scale energy storage systems (including lithium-ion batteries.

If the hazards are not considered in building design, they can present an increased fire risk to the building and its occupants.
There are currently no requirements in the Building Code that specifically address issues with green technologies. The building regulatory system needs to be flexible and allow for these and other new and emerging risks.
References to issues identified by stakeholders: SRG 1**,** SRG 3**,** SRG 5**,** SRG 8**,** SRG 10**,** SRG 12**,** STM 2**,** STM 11**,** STF 15**,** STM 20

D.4.4 Fires during construction can be a serious concern

Fire safety during construction is not just focused on prevention but also must consider provisions for means of escape and access and information for firefighting[89]. It is unclear what fire safety features are required by the Building Code during construction and we have identified this as an issue.

Issue 4-4. Construction fire hazards
F5 Construction and demolition hazards does not consider fire or other natural hazards during the construction or alteration of the building.

[87] Refer to Appendix B.1 and historical fire event HFE 22.
[88] Refer to Appendix B.1 and historical fire event HFE 80.
[89] Refer to Appendix B.1 and historical fire events HFE 8, 87, 92, 96, and 97 for fire during construction. The 2019 fire at the International Convention Centre in Auckland occurred during construction. Access to extinguish the fire was difficult and the active and passive fire protection systems were not yet operational on the upper levels. These factors contributed to the spread of the fire in the building.

Construction fires can be a serious concern as the necessary fire safety systems to protect against a fire may not be functional. This can lead to rapid fire development that:

- endangers the lives of construction workers and firefighters,
- spreads fire to other buildings, and
- impacts the community.

There are no provisions for fire safety and means of escape during construction in the Building Code. FENZ prepared a guide for firefighting on construction sites after the International Convention Centre in Auckland in 2019.

References to other Building Codes: NCC 22, ICC 18, ICC 6, ICC 7, ICC 15, NBCC 5

References to issues identified by stakeholders: SRG 1, SRG 5, SRG 8, SRG 10

D.4.5 Fire hazards outside the building

There are no considerations in the Building Code for external sources of ignition. There are records of wildfires destroying houses in New Zealand going back to 1872[90].

Other external sources of ignition not addressed in the Building Code include fires from:

- rubbish bins
- trees and shrubs
- vehicles
- advertising boards and large TV screens
- plastic storage tanks
- gas bottles
- battery storage
- air conditioning units
- electric transformers, overhead wires, or other electrical infrastructure.

FENZ previously reported on a fire in shed that spread to two different houses[91]. We have identified 2 separate issues related to fire hazards outside of the building.

Issue 4-5. Wildfire events

There are no special considerations for the protection of buildings from wildfire/bushfire events.

There is scope within the Building Code to provide measures for how buildings might be constructed at the wildland and urban/rural interface.

Hotter, drier and at times windy conditions in many areas of New Zealand increases the risk of wildfires. Without a change of building design to address the risks from wildfires, potentially more homes could be lost in future wildfires.

References to other Building Codes: NCC 40, NCC 41, NCC 42, NCC 43, NCC 46, NCC 49, NCC 50, NCC 53, NCC 54, ICC 20, WB 71

References to issues identified by stakeholders: SRG 1, SRG 5

Issue 4-6. Fire hazards on the outside of the building

There is no requirement in the Building Code to consider fire hazards on the outside of the building. This includes fires from:

- rubbish bins
- trees and shrubs
- vehicles
- advertising boards and large TV screens
- plastic storage tanks

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[90] Refer to Appendix B.1 and historical fire events HFE 103 to HFE 114.

[91] Refer to Appendix B.1 and historical fire event HFE 18.

- gas bottles
- battery storage
- air conditioning units

These sources can lead to:

- ignition of a fire and lead to a fire in a building
- boost the exterior vertical or horizontal fire spread from one building to another or from one floor to another, and
- create hazards when external evacuation or escape routes or stairs are close by.

References to other Building Codes: WB 5, WB 69
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 10, STF 15, STM 20

D.4.6 Fires involving hazardous substances

The processing, manufacture and storage of hazardous substances can cause fire, and the presence of hazardous and combustible materials can increase the fire size and its conditions.

A significant fire event involving hazardous substances in New Zealand occurred in 2008 at a coolstore in the Waikato[92]. A similar chemical explosion occurred in Melbourne, Australia on 10 July 2024 resulting in the spread of toxic smoke[93].

The risks of hazardous substances are covered in clause F3 of the Building Code and Health and Safety at Work Act 2015 and its subsequent regulations. But there are no specific measures that link to the Building Code requirements for fire safety. Other building codes internationally have addressed some of these hazards by creating categories or sub-categories of buildings that have assumptions and restrictions on the hazard and quantity of the hazardous substance[94]. It was recommended in 2007 that the Building Code be amended to ensure consistency with hazardous substances regulations[95] and we have identified this as an issue.

Issue 4-7. Fires involving hazardous substances
There are limited considerations for fires involving hazardous substances. They can be a :

- potential ignition source, and
- fuel or hazard that helps fire spread

C4 Movement to place of safety considers the impact of toxic gases other than carbon monoxide on people evacuating a building. It should be assumed that the Building Code has means to prevent hazardous substances, which can release toxic gases, from being involved in fire, but it is not clear that this has been considered.
References to other Building Codes: ICC 54, ICC 55, NBCC 11, NBCC 12, NBCC 13
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 8

D.4.7 We have identified 6 other significant issues related to fire hazards and prevention

We have identified other significant issues in our reviews of overseas buildings codes and through conversations with stakeholders.

Issue 4-8. Design fires and hazards
There are no clear provisions for what to consider for design fires or hazards in the New Zealand Building Code. C/VM2 contains some additional details as does the C/VM2 commentary guidance document. But the defined terms ‘fire’ and ‘fire hazard’ are not detailed enough, and there are no other specific fire safety requirements in the clauses. When designing fire scenarios they must consider:

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[92] Refer to Appendix B.1 and historical fire event HFE 69. The explosion was caused by a propane refrigerant leak and the resulting fire and explosion injured 8 firefighters and one of these firefighters later died in hospital.
[93] Refer to Appendix B.1 and historical fire event HFE 83.
[94] Refer to Appendix C for comparisons to international building codes.
[95] Refer to Appendix B.2 and report R008.

- the size of the fire event
- the potential spread of fire for any given fuel load
- the range of fire sizes expected
- how flammable the fuels are
- the peak heat release rates of the first item ignited
- the expected fire growth rates
- the peak heat release rates and production of smoke and other gases
- the tolerable levels of damage for a given fire event in a building
- the areas of fire origin and their impact on adjoining spaces
- sensitivity analysis including reasonableness, frequency, and severity of the design fire
- factors of safety and uncertainties

References to other Building Codes: ICC 36, ICC 37, ICC 38, ICC 39, ICC 40, ICC 41, ICC 42, ICC 43, ICC 44

Issue 4-9. Flammable refrigerants

Flammable refrigerants are used in building systems such as refrigerators, hot water tanks, heat pumps and air conditioning units. But fire safety of refrigerant gases is not addressed in the New Zealand Building Code. Clause G10 Piped services contains provisions for cold, flammable, and toxic fluids, the clause G10 acceptable solutions and verification method do not contain measures for the safe operation of refrigeration equipment or refrigeration equipment. There is a concern flammable refrigerants are used in existing systems that are not designed for this. It is expected that the use of flammable refrigerants will increase over time as hydrofluorocarbon refrigerants are being phased out as part of New Zealand's commitments under the Kigali Amendment to the Montreal Protocol. Consideration is required for the use of loss-of-pressure alarms, secondary circulation systems, or venting in enclosed spaces.

References to other Building Codes: ICC 12, ICC 13, ICC 14

References to issues identified by stakeholders: STM 20

Issue 4-10. Chimneys and flues

Fire prevention from heating appliances needs to consider components such as chimneys, flues, chutes and similar as potential heating elements and hazards to be mitigated.

Clause C2.2 does not clearly state these components as part of the appliances but there are standards and other requirements that provide measures to address the risk.

References to other Building Codes: NCC 33, NCC 51

Issue 4-11. Issue 4-11. Re-entry of smoke

Additional considerations are required so buildings:

withstand the temperatures generated by an appliance on fire

prevent smoke from escaping or re-entering through windows, ventilation inlets, or similar openings.

G4.3.4 contains a requirement for 'contaminated air' but does not clearly state 'smoke'. There are no specific considerations for smoke from heating appliances re-entering a building.

References to other Building Codes: NCC 47, NCC 51

Issue 4-12. Lift machine rooms

Lifts no longer have separate machine rooms and fire hazards are now happening within lift shafts.

The Acceptable Solution C/AS2 Paragraph 3.10.3 assumes that the lift machinery is contained within a fire separated room or otherwise protected from the building.

It is unclear what is acceptable fire safety protection in a lift fire event. A fire in the machinery can lead to fire and smoke spread in the vertical lift shaft through multiple levels. There are also implications for the cost and practicality in the construction of lifts where they are required to be fire separated.

References to issues identified by stakeholders: SRG 10, STM 7

Issue 4-13. Issue 4-13. Construction requirements in hazardous substance regulations

The Health and Safety at Work (Hazardous Substances) Regulations 2017 contain construction requirements for buildings to include fire safety features such as 4-hour fire rating and 4-hour rated fire door.

There are no direct references between the Building Code to these Health and Safety at Work (Hazardous Substances) Regulations 2017 requirements yet there are requirements for the design and construction of buildings. This can cause delays in the occupation of a building as owners have to re-design facilities to comply with these regulations after the building has been constructed.

In addition, there are limited options in New Zealand to buy fire rated doors that meet the Health and Safety at Work's requirements. In some cases, these buildings require exemptions from the hazardous substances regulations which may take a year or longer to be assessed and processed and are only granted for five years. This adds costs to the process for demonstrating compliance.

References to issues identified by stakeholders: SRG 5, STM 17

D.4.8 Seven other important issues for fire hazards and prevention

Issue 4-14. Fuel loads for different buildings

There are limited provisions in the New Zealand Building Code to limit the combustibles present or to consider the design of the building for the expected fuel load.

Limiting the quantities, types, or combustibility of materials can lower the risk of fire spread.

Very large exhibitions, TV screens, artwork, foam pits, inflatable structures, and similar can significantly contribute to fire growth and spread.

For storage, the term 'capable storage height' is used within Acceptable Solution C/AS2 to determine the requirements for storage buildings. This term is only described and discussed in a commentary guidance document and not defined or described in the acceptable solution.

There can be disagreements on the interpretation of these requirements and whether the description in commentary is to be applied since it is not within the acceptable solution.

References to issues identified by stakeholders: SRG 10, STM 7, STF 5

Issue 4-15. Large retail storage of dangerous goods

Large retail hardware stores and garden centres have increased the amount of dangerous goods stored in small containers but in large quantities, such as paint and aerosols.

The increase in fuel load and fire hazard of this type of storage may challenge the fire safety features of the buildings especially where sprinkler protection is not provided.

References to issues identified by stakeholders: STM 17

Issue 4-16. Tunnels

The Building Act 2004 defines tunnels and other infrastructure as buildings but the Building Code does not contain specific fire safety provisions to address them.

Not all aspects of the Building Code would be relevant for the different types of infrastructure but there are no clear statements of what is or is not required.

References to issues identified by stakeholders: SRG 1, SRG 8, STF 16, STF 19

Issue 4-17. Piped hydrogen gas

Hydrogen gas is being considered as alternate fuel sources instead of other flammable gases. But hydrogen presents a significant fire hazard as it is highly ignitable, odourless, and burns clear.

There are no Building Code requirements that address the fire safety risks of hydrogen although solutions exist overseas.

References to issues identified by stakeholders: STM 20

Issue 4-18. Outbuildings

Outbuildings includes sheds right through to large storage facilities such as educational (sports equipment storage), agricultural or industrial buildings. Yet all types of outbuildings regardless of size have the same fire requirements in C/AS1.

This means that the fire designs for large outbuildings may be inadequate for the hazards present. The main concern would be for external fire spread to adjacent property or buildings where a 1 m separation is provided between buildings 400 or 600 m^2 in size.
In contrast, in some cases, outbuildings are designed using C/AS2 which has a more difficult set of requirements to meet that may be uneconomical for some situations.
References to issues identified by stakeholders: SRG 1, STM 7, STF 7

Issue 4-19. Terminology in hazardous substances regulations
The Health and Safety at Work (Hazardous Substances) Regulations 2017 do not contain definitions for several considerations in the Building Code.
Terms in the Health and Safety at Work (Hazardous Substances) Regulations 2017 like fire rating, fire door, roof/ceiling, non-combustible are not specified and may conflict with similar terms in the Building Code. Because there are no direct references between them it can cause confusion working out what types of systems or materials are suitable for use.
References to issues identified by stakeholders: STM 20

Issue 4-20. Redundant Verification Method C/VM1
Verification Method C/VM1 references the same standard for fire prevention as already cited in C/AS1 and C/AS2. It is unclear why this document is required as it provides limited value as a standalone verification method.
References to issues identified by stakeholders: SRG 3

D.5 Fire spread

Fire can spread in buildings by igniting nearby objects, filling a room with heat and smoke, or moving through doors, windows, walls, or other openings to other rooms. If it reaches the building's exterior, it can spread to nearby buildings or other floors creating a larger fire. Containing or controlling the fire early is the key to stopping it from spreading further.

D.5.1 Fire spread on lining materials

Fires can spread quicker than people expect[96]. A contributing factor to this has been the fuel loads in a building or combustible lining materials used on walls, ceilings, and floors of buildings[97]. In the 2003 Station Nightclub fire in Rhode Island, United States, pyrotechnics on the stage ignited the flammable polyurethane soundproofing insulation on the walls and ceiling. The fire developed extremely quickly with unsurvivable conditions reached in as little as 90 seconds. While it is not possible for the Building Code to control all the contents of a building, the types of surface finishes in certain areas of a building can be restricted.

Restrictions on surface finishes have been identified in all overseas building codes reviewed for this paper[98]. Most codes restrict the types of finishes based on the use of the building. However, different countries can have ways to assess the performance of different materials. New Zealand adopted very prescriptive requirements into the code clauses in 2012 in Building Code clause C3.4. Some of the issues in the clause include:

- the use of terms that are not defined in the regulations
- requirements applying to buildings irrespective of their fire hazards. There is no specific consideration of the fire hazard they present to a building. For example, surface finishes on ceilings 3 meters above the floor are treated the same as surface finishes at the top of a multi-storey atrium

[96] Refer to Appendix B.1 and historical fire events HFE 8, 22, 29, 43, 51, 53, 55, 56, 58, 67, 78, and 79.
[97] Refer to Appendix B.1 and historical fire events HFE 43, 58, 63, and 73.
[98] Refer to Appendix C for a comparison to international Building Codes.

- requirements limiting the use of the applications of wood, wool, and other natural linings or structural members. This can make it difficult for timber marae buildings or toi whakairo to comply
- omission to consider toxic fumes from lining materials in a fire
- the inability to use common fire testing standards used in other Building Codes.

A key priority for this Government is removing barriers to overseas products. These issues with surface finishes and other testing methods in the Building Code can form barriers to the use of alternate products. We have identified barriers to using overseas products as an issue. Other issues affecting the cause are discussed in Section D.5.7. Other issues related to the fire testing of specific products are discussed in Section D.5.9.

Issue 5-1. Barriers to overseas products
The Government is looking to remove barriers to overseas products. But New Zealand specific fire testing requirements for surface finishes, cladding systems, and other fire rated products:

- limits the availability of products that can be used in the market in New Zealand, and
- slows down the process for bringing new products to market.

Specific concerns exist for:

- Standards in clauses A2 and C3.4 – The standards referenced in A2 and C3.4 for fire testing place prevent the use of different types of products from overseas. These standards are out of date and no longer align with fire testing used overseas and preclude the use of alternate standards used for fire testing overseas. Mentioning the standards in the Building Code prevents the use of alternate standards for fire testing. This means imported products will need to be retested.
- Fire door and door hardware testing to NZS 4520 which are specific to New Zealand and whether requirements in the standard such as latching through the duration of the test is required.
- Timber products – some of the standards in the regulations or in the acceptable solutions and verification methods exclude the use of combustible materials regardless of the fire hazard they present for the specific situation.
- Re-testing to newer versions of standards – the Acceptable Solutions C/AS1 and C/AS2 permit the use of older products without having to re-test. But this means that some products may have been tested decades ago to lower performance standards. This can create a higher bar for new market entrants, or potentially poorer performing products continuing to be used.
- Smoke control doors – the Acceptable Solutions C/AS1 and C/AS2 list the features of smoke control doors which includes timber doors but does not allow any other alternative materials.

References to issues identified by stakeholders: SRG 1, SRG 3, SRG 5, SRG 10, SRG 12, STM 13, STM 14, STM 19, STF 10, STF 11, STF 13

D.5.2 Smoke and toxic gases are a concern

The dangers of smoke spread have been documented in fire events internationally[99].

Smoke can spread into stairwells and other parts of the escape route, making evacuation difficult because of the reduced visibility. Smoke can also carry carbon monoxide or other toxic gases which make it difficult to breath and result in death. Most deaths in a fire are due to smoke inhalation and not from the heat.

Multiple fatalities occurred in the 1980 MGM Grand Hotel fire in Las Vegas. The fire originated on the first floor and smoke travelled throughout the hotel. Most of the deaths in this fire were due to toxic fumes and smoke spread via the ventilation system and connected spaces in the building.

This fire highlighted the hazard of smoke and toxic gases during a fire and smoke movement through the building. Smoke spread can also ignite fires in other parts of a building. We have identified an issue relating to the toxic gases released in a fire.

[99] Refer to Appendix B.1 and historical fire events HFE 25, 26, 27, 34, 46, 53, 54, 75, 83, 90, 93.

Issue 5-2. Toxic gases from surface finishes
Interior surface finish requirements in clause C3.4 of the New Zealand Building Codes considers the heat and smoke produced in a fire but not toxic gas productions.
Toxic gases can also be produced in fires involving hazardous substances.
At the same time, test standards for the performance of fire and smoke separations account for the passage of heat only and not smoke or toxic gases.
There is no limit to what toxic gases may be given off during a fire. With modern materials (plastics) more widely used now, there is a large body of evidence to consider toxic gases and their effect on vision, breathing and incapacitation.
References to other Building Codes: ICC 23
References to issues identified by stakeholders: SRG 1, SRG 3, STF 16, STF 19

D.5.3 Passive fire protection

Passive fire protection includes systems of materials and products that can resist the spread of smoke and fire. This includes fire and smoke separations, fire and smoke stopping, dampers, doors, internal lining materials, and cladding.

Creating fire or smoke separated compartments is vital for controlling fire spread, facilitating evacuation, and enabling firefighting responses. The benefits of passive fire protection have been recognised[100]. Proper passive fire protection can save lives and limit the extent of damage from the fire.

While New Zealand has requirements in the acceptable solutions for passive fire protection, there are limited explicit provisions in the regulations for these systems. Other countries have included additional provisions to state where compartmentation is required and how fire or smoke separations are to be constructed[101]. Lacking these provisions in the code can cause confusion on what is required and limit the use of alternative solutions as building consent authorities are only willing to accept what has been fire tested in accordance with the acceptable solutions. Modern construction methods and modular builds can be particularly challenging as the details necessary for construction are not even contemplated by the documents.

While the benefits are recognised, there has been issues with the reliability of passive fire systems[102]. Following the tragedy at Loafers Lodge, MBIE inspected similar properties throughout New Zealand to assess the fire safety in boarding houses. Many of the buildings had inadequate fire and smoke separations (including fire and smoke stop doors). Similar concerns around passive fire protection were identified in an external review in 2016[103].

Non-functioning systems can lead to more rapid fire spread and exposure of occupants to smoke and hot gases. A 2007 review recommended that the Building Code address the risk to fire safety when systems fail to function as expected[104].

We have identified two significant issues relating to passive fire protection:

Issue 5-3. Performance criteria of passive fire protection
C3 Fire affecting areas beyond the fire source does not explicitly state when fire separations are required. Compartmentation is necessary to control fire spread, help evacuations, and support firefighting responses. Where fire separations are required, the New Zealand Building Code clauses C1-C6 do not clearly state how they are to be constructed or how openings and penetrations must be protected to maintain the integrity of the fire separation.

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[100] Refer to Appendix B.1 and historical fire events 8, 17, 23. During the fire at the Parliament buildings in 1907, the fire spread rapidly through the buildings but the library was saved by its fire walls and metal fire door.
[101] Refer to Appendix C and comparisons to international building codes.
[102] Refer to Appendix B.1 and historical fire events HFE 16, 33, 36, 40, 59, 79.
[103] Refer to Appendix B.2 and report R022.
[104] Refer to Appendix B.2 and report R008.

This includes the use of passive fire protection features such as fire and smoke separations, fire stopping, smoke stopping, fire and smoke curtains, spandrels, and fire doors.
As such, it is unclear what passive fire protection is required to do and how they are required to perform in fire testing.
This can also limit the use of alternative solutions as building consent authorities are only willing to accept what has been fire tested in accordance with the acceptable solutions.
References to other Building Codes: NCC 4, NCC 9, BR 3, WB 1, WB 2
References to issues identified by stakeholders: SRG 5, SRG 10, STM 13, STM 14, STM 15, STF 12, STF 13

Issue 5-4. Reliability of passive fire protection
There is a specific concern that passive fire protection systems including fire stopping, fire dampers, fire doors, and surface finishes installed in New Zealand are not installed correctly and may not perform as expected.
There is limited passive fire safety system consideration:

- for what happens if they do not function as expected, and
- on the measures to ensure that they do function.

Non-functioning systems can lead to more rapid fire spread and exposure of occupants to smoke and hot gases. The reliability of different fire safety systems needs to be considered.
References to issues identified by stakeholders: SRG 7, SRG 8, SRG 10, STM 3, STM 7, STM 9, STM 14, STF 7, STF 11

Figure 12. An open fire door

D.5.4 Sprinklers can control fire spread

Automatic fire suppression systems such as water-based sprinklers are effective at controlling fire spread which can reduce the amount of smoke[105]. But the Building Code clauses have limited provisions which consider both the use of fire-resisting elements and fire separations along with sprinklers.

[105] Refer to Appendix B.1 and historical fire events HFE 61, 78, 87. Also refer to McGree, T. (2024-04-01), "U.S. Experience with Sprinklers", National Fire Protection Association. Available online from: https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/us-experience-with-sprinklers

Other codes more clearly recognise the benefits and trade-offs of using fire separations and sprinklers[106]. We have identified this as an issue in the building code.

Issue 5-5. Fire resisting elements and automatic fire suppression
Provisions to limit fire spread and growth should consider both the use of fire-resisting elements and fire separations along with automatic fire suppression systems.
Sprinklers are effective at controlling fire spread. There are also no specific statements in the Building Code on how passive and active features are to work together to minimise fire spread. This has the following implications:

- It is unclear how the presence of sprinklers should be incorporated into structural design in Building Code clause C6.
- There are no specific provisions within C3 Fire affecting areas beyond the fire source that require the use of sprinklers and there are limited considerations when sprinklers are provided. This creates inconsistencies with the acceptable solutions as there are many situations when sprinklers are required in the acceptable solutions including high occupancy buildings, taller buildings, hospitals, detention facilities, and warehouses. In some cases, there are trade-offs for one type of system versus another provided in the acceptable solutions.
- The definition of a burnout fire in clause A2 of the Building Code specifically prohibits any consideration of sprinkler suppression in the assessment. This definition is subsequently referenced for a place of safety by the Fire and Emergency New Zealand (Fire Safety, Evacuation Procedures, and Evacuation Schemes) Regulations 2018 and can result in overly complicated processes for meeting compliance with building designs.

References to other Building Codes: NCC 21, ICC 27, BR 3, WB 44, WB 51
References to issues identified by stakeholders: SRG 1, SRG 10, STM 17, STM 21

D.5.5 There is more knowledge on cladding fire risks since Grenfell Tower

Following the Grenfell Tower fire in 2017 and other recent cladding fires, there has been a significant movement around the world to remove flammable cladding from existing buildings and update controls on cladding fire hazards[107]. To prevent fire spreading from buildings, external walls have historically been required to be constructed with non-combustible materials[108]. This is often challenging in modern buildings due to the products used to comply with provisions for weathertightness, thermal comfort, acoustics, and other measures of building performance due to the cost.

The Building Code contains two clauses which are intended to limit or prevent cladding fires. Clause C3.5 is intended to reduce the risk of flame spread via the external wall surfaces of buildings to 3.5 m. The intention is to reduce the likelihood of fire spreading into upper floor levels, which creates a hazardous situation for firefighters and prevents occupants from escaping from the building. Clause C3.7 restricts the ignitability of materials that may be used on the external wall within 1 meter of a boundary.

While we have advanced the fundamental knowledge of fire spread in a cladding system, there has been no change to the relevant provisions in the Building Code regulations to incorporate these learnings, although the concerns have resulted in several aluminium composite panel Codemark certificates to be suspended[109].

Clause C3.5 does not explicitly address all aspects of the fire performance of a cladding system such as the fire stopping of floor joints in curtain walls or fire spread in cavities. Clauses C3.5 and C3.7 are not proportional to the fire risks they are trying to mitigate. We have identified issues with these clauses.

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[106] Refer to Appendix C and comparisons to international building codes.
[107] Refer to Appendix B.1 and historical fire events HFE 86, HFE 94, and HFE 95.
[108] Refer to Appendix B.1 and historical fire events HFE 3. Following this fire, Christchurch passed an ordinance to require new buildings in the city centre to have external walls made of non-combustible materials.
[109] Six ACP CodeMark certificates removed | Building Performance

Issue 5-6. Fire safety of external cladding
External cladding requirements are not well defined in the Building Code clauses.
Clause C3.5 contains requirements to limit vertical fire spread on the exterior of a building to 3.5 m. It does not clearly address all aspects of the fire performance of a cladding system such as fire stopping of floor joints in curtain walls or fire spread in cavities.
There are other problems with Clause C3.5 including the use of the words 'vertically', 'over the external cladding', and 'fire' (which includes both flames and smoke in its definition).
The limit of 3.5 m is also very rigid and assumes the same single height between storeys for all buildings which is inconsistent with:

- acceptable spandrel heights of 1.5 m in the acceptable solutions, and
- the heights where temperatures are measured in fire tests.

This performance clause also does not align with the functional requirement in C3.2. Consideration is required to make this requirement proportional to the fire risks it is trying to reduce.
References to issues identified by stakeholders: SRG 1, SRG 3, SRG 5, SRG 10, STM 7, STF 12

D.5.6 Roofs contain combustible materials

The Building Code does not consider fire spread to, from, or over roofs or in ceiling assemblies.

In the 2019 New Zealand International Convention Centre fire, the fire spread in the roof assembly which burned for days[110]. A similar roof fire event occurred at the Parliament buildings in Wellington in 1992[111].

Combustible roofing material was also a factor in the 2017 Grenfell Tower fire which escalated the fire spread to other parts of the building.

Other building codes overseas specifically address the fire safety considerations in the construction of roofs[106] and we identified this as an issue.

Issue 5-7. Roofs
C3 Fire affecting areas beyond the fire source does not consider fire spread to, from, or over roofs or in ceiling assemblies.
References to other Building Codes: BR 5, WB 1, WB 4, ICC 31
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 10

D.5.7 Other issues in clause C3 Fire affecting areas beyond the fire source

We have identified 9 other issues impacting the C3 code clauses including the functional requirements and performance criteria.

Issue 5-8. Fire spread functional requirements
It is not clear how requirements for fire spread relate back to the Building Code objectives in C1 and functional requirements in C3 except where a building has a sleeping occupancy or other property.
C3.1 only has broad statements about limiting fire spread to protect people not close to fire.
C3 Fire affecting areas beyond the fire source has limited performance criteria related to firefighting and no functional requirements for firefighting. Limiting fire and smoke spread helps protect firefighters in suppression and rescue operations.
References to other Building Codes: ICC 25
References to issues identified by stakeholders: STM 7

Issue 5-9. Preventing fire spread
C3 Fire affecting areas beyond the fire source considers limiting fire spread but not preventing it.

[110] Refer to Appendix B.1 and historical fire event HFE 96.
[111] Refer to Appendix B.1 and historical fire event HFE 8.

Appendix D. Identified building code issues

Limiting fire spread may not be clear as to what is required for the design whereas preventing fire spread is a more direct way of achieving the fire safety objectives. Preventing fire spread requires additional considerations of:

- providing occupants with sufficient time to evacuate
- allowing for fire service intervention
- protection of adjoining fire compartments and other buildings.

References to other Building Codes: NCC 2

Issue 5-10. Design conditions for fire spread

C3 Fire affecting areas beyond the fire source does not specify that both the rate of heat release and the rate of fire growth are important in limiting fire spread.

At the same time, it is not always possible to limit all forms of fire spread especially where consideration of human behaviour and the nature of fire is taken into account. But there are no specific dispensations or exemptions in the New Zealand Building Code to consider expected events versus extreme worst-case events.

References to other Building Codes: NCC 44, NCC 45, BR 1

Issue 5-11. Building descriptions for surface finishes

The Acceptable Solution C/AS2 contains requirements for different risk groups. But there are inconsistencies between the:

- building classifications in C/AS2 Table 1.1
- classified uses in clause A1 of the Building Code, and
- descriptions of occupancies in the surface finish requirements in clause C3.4 of the Building Code and Table 4.3 of C/AS2.

This makes it unclear what materials can be used for what types of buildings.

References to issues identified by stakeholders: STF 6

Issue 5-12. Sustainable lining materials

Surface finish requirements in clause C3.4 limit the applications of wood, wool, and other natural linings or structural members. In some cases, the requirements are not proportional to the risk and territorial authorities grant waivers or modifications of the Building Code to permit the use of certain linings.

This places an additional burden on the applicant and does not help meet expectations for a sustainable built environment.

References to issues identified by stakeholders: STM 7, STM 18, STF 8

Issue 5-13. Flooring performance testing

Clause C3.4(b) contains requirements for the fire performance of flooring and states that flooring must be tested to ISO 9239-1: 2010.

This standard requires that the testing of the flooring includes any substrate if used and the substrate, underlay or other changes of the flooring may affect test results. But C3.4(b) refers to floor 'surface' materials and does not clearly state that the substrate needs to be considered.

This creates an inconsistency in the wording of clause C3.4 (b) that can result in the flooring system not performing as expected and a negative impact to its performance if not installed with the correct substrate. This also creates a challenge for flooring suppliers trying to ensure the reliability of their products.

References to issues identified by stakeholders: STF 7

Issue 5-14. Fire spread in internal spaces

The New Zealand Building Code does not contain clear provisions to prevent fire spreading in internal spaces. There are requirements found in the acceptable solutions but the code clauses regulate internal fire spread in a roundabout way through clauses C4 and C5 for the protection of occupants and firefighters.

Considerations are required for internal spread of fire and smoke in large areas, spaces connecting several floors, stairs, shafts, void spaces, concealed spaces, vertical openings, wall, floor, roof and ceiling assemblies.

References to other Building Codes: ICC 29, ICC 30, ICC 33, ICC 34, WB 1, WB 7

Issue 5-15. Fuel loads
There are limited provisions in the New Zealand Building Code to limit the combustibles in the building or to consider the design of the building for the expected fuel load for either temporary or permanent situations. Limiting the quantities, configurations, or combustibility of materials can limit fire spread, growth, and duration.
Excessive fuel loads can have significant impacts on the fire safety of the building. Any assumed fuel loads must consider the consequence and likelihood if that load is exceeded.
References to other Building Codes: ICC 24

Issue 5-16. External walls close to the boundary
There are inconsistencies in Clause C3.7 and the design and fire testing of external walls.
This clause the limits the ignitability of external walls for different types of buildings. The criteria of exposure of 30 kW/m^2 and durations of 30 minutes do not align with the test criteria of 50 kW/m^2 and 15 minutes described for small scale testing in the appendices for the Acceptable Solutions C/AS1 and C/AS2.
'External wall' is not shown in italics in Clause C3.7, and it is unclear if this is to refer to the defined term used elsewhere in the Building Code system.
It is also unclear what components in an external wall these restrictions apply to and if they only apply to the outer-most surface. This causes confusion on whether this test criteria can be used for certain building types.
References to issues identified by stakeholders: SRG 3, STM 13

D.5.8 Compliance assessment methods

There are 4 issues identified with the methods related to fire spread in acceptable solutions and verification methods used to demonstrate compliance with the Building Code.

Issue 5-17. Modelling rules for current construction methods
The modelling rules provided in Verification Method C/VM2 assume certain types of construction and this impacts the parameters given and fire dynamics captured. This includes the leakage areas through different types of construction, and the fire performance of glazing.
As buildings are becoming more airtight and include more insulation and thicker windows, the assumptions in C/VM2 no longer align with current construction methods.
With more airtight construction, the fire may become ventilation limited much sooner and therefore the temperature may not reach the threshold for the glass to break.
The C/VM2 criteria were also set when single glazing was commonplace. In some cases, this can create more hazardous fire scenarios than designed for.
References to issues identified by stakeholders: SRG 3

Issue 5-18. Atriums
Atriums and interconnected stairwells are quite common in buildings and are expected to remain popular design features. But there is limited consideration for addressing fire spread in these spaces.
Atriums are out of scope of Acceptable Solution C/AS2 and must currently be designed as an alternative solution or through the use of C/VM2.
Further consideration is required on the simple, practical fire safety features that can be used for atriums and interconnected floors.
References to issues identified by stakeholders: STM 2, STF 1, STF 2, STF 4

Figure 13. An atrium with interconnected stairwells between the levels

Issue 5-19. Smoke layer
Clause C3.8 is intended to limit the build-up of smoke and heat in large compartments and puts limits on the height of the "smoke layer" in a building. But there is no indication of how the smoke layer is measured.
Some computer models output a quantity for this directly, but smoke can be dense and concentrated or quite wispy without a well-defined layer and must be approximated.
There are a variety of ways this can be done, and these are not specified in the Building Code.
At the same time, Clause C3.8 refers to the 'time that firefighters first apply water' but how this is determined is not specified.
References to issues identified by stakeholders: STM 7, STF 13

Issue 5-20. Horizontal fire spread assessment methods
The Acceptable Solution C/AS2 contains various ways to limit the fire spread between buildings. One of these includes the use of the 'enclosing rectangle' method provided in Verification Method C/VM2. It can be difficult to use because:

- it is unclear how C/AS2 and C/VM2 are to be used together and whether the method must be used alongside other elements of C/VM2.
- the method can be complex for basic situations involving buildings that are stepped or at angles with each other.

References to issues identified by stakeholders: STM 7, STM 19, STF 15

D.5.9 Fire testing and product performance

We have identified 10 issues related to fire testing and product performance. These relate to the testing parameters and the acceptance criteria within individual tests.

Issue 5-21. Smoke separations
The expectations for smoke leakage and smoke separations are unclear.
Although the Building Code provides a definition for smoke separation, this only describes the construction materials and fire resistance rating (if required).
No performance criteria are set to identify whether smoke spread is permitted and if so, what is acceptable with regards to smoke leakage. This could be taken to mean that no smoke leakage is permitted in fire and smoke separations. But building elements tested to AS1530.4 are not also tested for smoke spread.

Many types of fire-rated construction, including fire-stops and shutter devices, do not completely prevent smoke leakage.
It is unclear if features like speakers, mechanical vents, and other penetrations can be included. And whether features like motorised smoke dampers are always necessary in vents when other openings may have limited consideration for their design.
References to issues identified by stakeholders: SRG 10, STF 15

Issue 5-22. Fire test methods
Not all fire test methods are appropriate for assessing the performance of building products, construction methods, or system of products.
Some products can melt or drip away from burners which will positively affect their performance in a test but does not represent better performance in a fire scenario.
Different products and combinations of multiple components will impact the performance of the system in different ways. This is most significant for external walls or fire rated assemblies comprising of multiple components.
Intermediate scale and large-scale testing are necessary for more complex and challenging situations. The types of testing required must reflect the specific attributes for different products.
References to issues identified by stakeholders: STM 14, STM 15, STM 18, STF 9

Issue 5-23. Assessments of fire performance
Fire testing of all fire stopping products or configurations may not be feasible or cost effective for all situations.
It is unclear in the Building Code where an assessment of fire testing of fire stopping is acceptable versus tested systems, and what the hierarchy of importance is.
Where assessments are used, these should be conservative. More testing can be used to remove conservatism.
References to issues identified by stakeholders: STM 14, STM 15

Issue 5-24. Fire and smoke dampers
The requirement for, and application of fire and smoke dampers does not appear to be matched with the type of the separation and the level of risk intended to be controlled. For example, a fire separation is generally intended to provide a higher level of protection than a smoke separation.
Under C/AS2, a fire damper with a fusible link is permitted in a fire separation but not in a smoke separation, with a smoke separation requiring a motorised damper to close on a fire signal.
While smoke separation requirements are generally less strict than those for a fire separation, the activation of smoke dampers is stricter than for fire dampers.
References to issues identified by stakeholders: SRG 10

Issue 5-25. Cavity barriers
The requirements for cavity barriers in the acceptable solutions are unclear.
There are no standards cited for their performance. They are also discussed in Part 4 in relation to control of internal fire spread but are mainly used to control external fire spread.
There is specific concern with intumescent cavity barriers which may activate after a fire has spread to an upper level, and concern with how a cavity barrier maintains the fire separation after a cladding material falls away.
References to issues identified by stakeholders: SRG 3

Issue 5-26. Fire doors and fire bolts
Fire bolts may be used as part of a fire door to ensure the door leaf remains latched in a fire.
These features of a fire door are not clearly addressed in the Building Code.
Acceptable Solution C/AS2 3.15.2 requires that egress doors must be opened in a normal manner. But once activated, a fire bolt prevents the door from being opened normally without tools or additional force.
The operating temperatures for these fire bolts can be quite low in order to demonstrate compliance in fire testing. If the doors cannot be opened, this can potentially impact occupants and firefighters evacuating from a building.
References to issues identified by stakeholders: SRG 3

Issue 5-27. Generic flooring materials
C/VM2 Appendix B contains a description of flooring materials that can be used generically to comply with clause C3.4(b) without the use of additional fire testing.
The note to Table B1 states that this can include surface coatings applied not more than 0.4 mm thick and not more than 100 g/m^2. These numbers are incompatible with each other and often 100 g/m^2 would be a more difficult requirement to meet.
It is unclear from this table whether both requirements are to be met.
References to issues identified by stakeholders: STM 13

Issue 5-28. Fire testing from above a floor
Acceptable Solution C/AS2 Paragraph 4.17.5 specifies that a flooring assembly is acceptable if it meets prescribed performance criteria when fire tested from the flooring side (that is from above the floor).
There is no standard fire test that exists for this purpose.
References to issues identified by stakeholders: SRG 3

Issue 5-29. Fires in corners
Acceptable Solution C/AS2 Paragraph 4.17.6 (f) provides exemptions for the use of timber shear walls but does not limit this where walls may meet at a corner.
Fires starting or getting to a corner will result in quicker fire growth than fires in the open along a wall.
This is a concern in the initial stages of a building fire as it may impact the evacuation of occupants from the building as a fire develops more quickly than what was considered in the design.
References to issues identified by stakeholders: SRG 3

Issue 5-30. Weathering of timber cladding
Acceptable Solution C/AS2 Appendix C7.1.3 requires timber cladding materials with fire retardant treatments to be subject to accelerated weathering in accordance with ASTM D 2898.
There is no requirement for other timber cladding systems tested at full-scale (for example BS 8414) to undertake accelerated weathering.
References to issues identified by stakeholders: SRG 3

D.5.10 Details of acceptable solutions

We have identified seven other issues related to the construction details and provisions in the acceptable solutions related to fire spread.

Issue 5-31. Modern methods of construction
The fire provisions within the acceptable solutions have not kept pace with modern methods of construction including mass timber, modular buildings, or offsite manufacturing.
Modern construction configurations and details are not well reflected in the requirements or images and are not even considered by the documents. This causes confusion when trying to process a building consent for a building using a modern construction method, leading to inconsistent outcomes across the country.
References to issues identified by stakeholders: SRG 1, SRG 5

Issue 5-32. Passive fire requirements in other parts of the Building Code
Passive fire protection features in New Zealand buildings need to be designed and installed to account for other factors such as seismic movement, acoustics, durability, and carbon cost.
There is currently no clarity on what the required performance is for seismic movement of passive fire systems that need to be designed up to the service limitability state.
Durability of passive fire protection features are not well laid out in clause B2 of the Building Code.
Passive fire systems generally require the same duration for durability for other components in a building such as cladding.
For some passive features, such as smoke curtains, the in-service expectations of how often they will be activated and replaced should be considered.
References to issues identified by stakeholders: SRG 1, SRG 8, SRG 10, STM 14

Issue 5-33. Cladding requirements in other parts of the Building Code

Fire safety of exterior cladding systems has to be integrated and coordinated within other clauses of the Building Code including E2 Exterior moisture, G6 Airborne and Impact Sound, G7 Natural Light and H1 Energy Efficiency.

Modern buildings in New Zealand are more likely to have more complex cladding systems that consider weathertightness, moisture control, and thermal performance.

In the case of the 2017 Grenfell Tower fire, upgrades to the building's energy efficiency resulted in combustible insulation on the exterior of the building which was a primary factor in the rapid fire spread on the building and the loss of life.

References to other Building Codes: WB 68

References to issues identified by stakeholders: SRG 8, STM 8

Issue 5-34. Unprotected openings in acceptable solutions

The acceptable solution requirements for complying with the requirements of Clause C3.6 are inconsistent. For example, C/AS1 places no limit on unprotected areas in external walls for single-unit dwellings that are more than 1 m from a boundary. But any walls within 5 m of the title boundary of multi-unit dwellings with units one above the other must be fire-rated unless these are glazed.

This approach is at odds with the risk presented by the differing building configurations. It can lead to the wrong compliance outcomes and add unnecessary building or design costs that do not comply with the performance criteria.

C/AS2 provides table values for allowable unprotected area, but some configurations do not meet the Building Code performance requirements when compared to specific calculation methods.

References to issues identified by stakeholders: SRG 10

Issue 5-35. Balconies

It is unclear how vertical fire spread requirements apply to balconies.

There are no explicit requirements in clauses C1-C6 to address the fire protection of balconies including vertical and horizontal fire spread, and fire ratings.

Balconies can be open on 1, 2, or 3 sides and be enclosed above. These different configurations result in different fire safety considerations.

It is also unclear if the balconies can function as aprons to limit the fire spread from below.

Other considerations for balconies include means of escape features including door hardware and travel distances, and the extent to which external fire spread needs to be assessed.

References to issues identified by stakeholders: SRG 10, STF 15

Issue 5-36. Shared walls

Clauses C3.6 and C3.7 do not address the protection of other property where there is a shared wall along a boundary or an inter-tenancy wall.

The performance in a fire test for a fire rated wall would require the fire separation to perform as a whole, with the failure criteria measured on the non-exposed side and not the middle of the wall.

Disagreements on the interpretation can result in delays in consenting.

References to issues identified by stakeholders: SRG 5, STM 13, STF 15

Issue 5-37. Open-sided structures

It is unclear how horizontal fire spread requirements apply to open sided structures such as carports.

Horizontal fire spread is generally assessed assuming there are external walls present with a limited area of unprotected openings. But open sided structures will not have walls on every side, and small open sided buildings such as porches may not have any fire load.

These would present a different fire hazard than an enclosed structure.

References to issues identified by stakeholders: STF 15

D.5.11 Definitions

We have identified 5 other important issues related to the terminology and definitions found in the Building Code which cause confusion and frustration to users of the documents.

Issue 5-38. Intermediate floors
Intermediate and mezzanine floors are not adequately defined, which leads to an inappropriate use of the terms, possibly beyond the intent of the definition. The expectations for integrity, insulation, and smoke leakage through mezzanine floors are also unclear.
One interpretation is that mezzanine floors only need to provide structural adequacy. Another interpretation is that floors need to be completely fire-rated including fire-stopping of services penetrations, and the only 'opening' permitted is at the ends of the floor that form the perimeter of the floor.
There are inconsistent design approaches and approvals. Similar questions also apply to stairs serving mezzanine floors.
References to issues identified by stakeholders: SRG 5, SRG 10

Issue 5-39. Notional boundaries
The notional boundary definition and requirements for buildings on the same property can result in more complex design outcomes such as when assessing spread of fire across legal road, public open space, and railway property (as examples).
This is because the notional boundary is required to be 1 meter off the face of the adjacent building, but the same requirement is not applied when considering the far side of legal road, public open space, railway property etc.
This assessment methodology is further worsened in C/AS2, which requires a notional boundary to be 'fixed' between two buildings, rather than considering the risk one building presents to the other.
References to issues identified by stakeholders: SRG 10

Issue 5-40. Fire performance of cladding in C/AS1
It is unclear how the requirements for the fire performance of cladding materials apply in Acceptable Solution C/AS1. This creates confusion on whether specific cladding requirements are applicable. This can result in potentially unsafe non-compliant solutions being designed and constructed.
References to issues identified by stakeholders: STF 16

Issue 5-41. Terminology used for external walls
There are several of definitions and terms for the construction of external walls in the Building Code, associated acceptable solutions and verification methods, and guidance documents. None of them make it clear on what is required for the fire testing of different systems. The definitions and terms include:

- external wall
- cladding system and cladding products
- external wall cladding and external wall cladding systems
- base-wall assembly
- façade
- building envelope
- complete wall assembly
- external wall assembly

References to issues identified by stakeholders: SRG 5, STM 13

Issue 5-42. Building height definition
The term 'building height' and associated wording around the 'top of the highest occupied floor' is unclear whether it applies to the floor surface or the ceiling of the floor.
Other definitions such as 'escape height' refer to the floor level as the walking surface.
It is also unclear how the construction of the roof and the roof height factors into this consideration. This confusion can result in delays during consenting when trying to determine what fire safety features are required for different heights of buildings.
References to issues identified by stakeholders: SRG 5, STM 13

Issue 5-43. Fire resistant piping
There is no clear definition in the New Zealand regulatory system for fire resistant piping and what types of piping may be acceptable for things like diesel supply to standby generators.

References to issues identified by stakeholders: STM 17

D.6 Fire safety systems

The fire safety systems discussed in this section include fire alarms, sprinkler systems, emergency lighting, exit signs, smoke control systems, and the interconnection and functioning between systems. These are installed to:

- warn people of a fire
- help provide safe evacuation
- facilitating firefighting operations
- restrict the spread of fire, and
- limit the impact of fire on the structural stability of the building.

Where these systems are present, there are expectations for how the systems and features will perform and how they will work together.

D.6.1 Expected level of performance of fire safety systems

While there can be many systems in a building, the Building Code regulations C1-C6 do not specify when certain features are required or what their performance must be. These requirements are often left to acceptable solution and verification methods with specific details of how systems are to be designed, installed, and maintained in standards. Having these provisions in the regulations may make it more clear how the fire safety systems in a building are expected to work and work together.

In comparison, other building codes from overseas contain provisions for how fire safety systems such as fire alarms, sprinklers, and smoke control systems are to perform[120]. This affects how the standards for these systems are developed.

Without basic settings at regulatory level, this can lengthen processes when acceptable solutions or standards are developed and amended as it is unclear what the outcomes or content of these documents should be.

Similarly, the technical development of fire safety systems is moving faster than the Building Code, acceptable solutions and cited standards can be updated. The lack of specified performance in the code clauses means that it can be difficult to use alternative solutions as the level of performance required is unclear. We have identified one issue related to this item.

Issue 6-1. Changes in technology
The technical development of fire safety systems is moving faster than the Building Code and the cited standards can be updated. There are barriers to using new technologies or the latest versions of standards until they are cited.
References to issues identified by stakeholders: SRG 6

D.6.2 Fire safety systems may not always function as expected

Where any fire safety system is present, there are expectations for how the systems and features will perform and how they will work together. But fire safety features may not always respond or operate as intended.

In 2024, MBIE reported in Operation Magazine on inadequate or compromised fire alarm systems in existing boarding houses[112].

[112] Refer to Appendix B.1 and historical fire event HFE 40.

FENZ has also reported on instances when sprinkler systems were turned off, smoke control systems did not activate, or there were delays notifying the fire service in the event of a fire[113]. These issues can lead to worse outcomes from a fire.

While some clauses of the Building Code (such as C3.9 or C4.5) require consideration of fire safety systems and the likelihood and consequence of failure, previous reviews of the Building Code found that these clauses were not clear[114]. Past reviews of the Building Code have recommended to ensure that buildings are robust enough to withstand the failure of a single system[115].

This was similarly recommended for consideration as a result of the investigation in the World Trade Centre collapse[116]. The impact of the planes hitting the towers on September 11, 2001 resulted in multiple systems failing to operate in the building due to insufficient robustness in their design.

Emergency power requirements also need to be considered across the building design to ensure different building features continue to operate when needed in an emergency.

We have identified 2 issues related to these items.

Issue 6-2. Reliability of fire safety systems
There is limited fire safety system consideration on:

- what happens if a fire safety system does not function as expected
- the measures to ensure that they do function.

There are considerations within some fire safety standards and provisions in the acceptable solution as well as non-specific language in C3.9, C4.5, and C5.8.
Non-functioning systems can lead to more rapid and/or wider fire spread, or exposure of occupants to smoke and hot gases. The reliability of different fire safety systems should be considered as part of the design.
References to other Building Codes: NBCC 1, NBCC 14
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 10

Issue 6-3. Emergency power
Emergency power is not required for essential services in fire or other emergencies in the New Zealand Building Code. Emergency power requirements need to be considered across the building design. At the same time, emergency power systems must be protected from fire themselves. In the event of a power outage or other emergency, people may have difficulty evacuating from tall buildings or in care facilities or hospitals.
References to other Building Codes: NCC 8, ICC 15, NBCC 10, WB 70
References to issues identified by stakeholders: SRG 1, SRG 5

D.6.3 Fire alarm and warning systems

Building Code clause F7 Warning Systems contains requirements for the notification of occupants in a building. This includes when fire alarm systems are activated.

For those with hearing impairments, visual alerting devices can be used to notify when a fire alarm has activated in a building. These devices can also be used where the ambient background noise is too loud for audible alarms such as plant rooms. There are no explicit provisions for visual alerting devices in F7 Warning Systems or C4 for when they are required or what level of performance they are required to have. Building

[113] Refer to Appendix B.1 and historical fire events HFE 62, 75, 81, 97. In one instance, a fire occurred in a hospital building when the sprinkler system was under maintenance. However, the fire alarm system had also been isolated as part of this work. This meant that staff had to individually notify the occupants in the building after the fire was identified. It also meant that door hold-open devices connected to the fire alarm system failed to activate and smoke travelled freely within the building.
[114] Refer to Appendix B.2 and report R019.
[115] Refer to Appendix B.2 and report R009
[116] Refer to Appendix B.1 and historical fire event HFE 88.

codes from the US and Canada require visual alerting devices to be placed in locations such as public corridors or boarding houses[117].

The New Zealand Building Code also does not limit how loud audio alarms are to be except within individual standards. Excessive volume of alarms can be disorienting anyone exiting a building. Other building codes, such as in Canada, contain requirements to limit the maximum sound level[117] and it was recommended in 2007 that the New Zealand Building Code contain a similar provision[118].

We have identified 7 issues related to fire alarm and warning systems in buildings.

Issue 6-4. Visual alerting devices
There are no clear requirements for visual alerting devices in F7 Warning Systems, including for when they are required or what level of performance they must have.
These devices are used to notify those with hearing impairments of an emergency. They can also be used where the ambient background noise is too loud for audio alarms such as factories or plantrooms.
References to other Building Codes: NCC 15, WB 17
References to issues identified by stakeholders: SRG 10, STF 15, STF 18

Issue 6-5. Activation of fire alarm systems
There are no specific requirements for how a fire alarm system should activate in F7 Warning Systems or what types of hazards it should respond to be it heat, smoke, carbon monoxide, manual activation, or flames.
At the same time, there are no direct links between the F7 Warnings Systems and other requirements in clauses C1-C6 on the fire and life safety strategy and assumptions made.
Some of these considerations are provided for in the acceptable solutions and verification methods and associated standards. Improper specification of the fire alarm system can result in false alarms if inappropriate detectors are installed in certain areas.
Where suppression systems are provided, they function as heat detectors and, when a sprinkler activates, it should notify the building occupants and others (such as the fire service and system technician) that water is flowing.
Sprinkler systems must also be monitored to ensure that there is no tampering.
References to other Building Codes: ICC 26, WB 48, WB 49, WB 50, WB 52
References to issues identified by stakeholders: SRG 8

Issue 6-6. Smoke detector coverage
C/AS2 Table 3.2 is inconsistent with NZS 4512: 2021. The first note under Table 3.2 refers to not less than 70% of the firecell shall be protected with smoke detectors for a Type 4 system. This should be updated to be aligned with NZS 4512:2021, or simply refer to NZS 4512:2021 to determine the type of fire alarm system the building has.
A building could be Type 4 compliant under NZS 4512:2021 but unable to use the open path length limits for a Type 4 system due to smoke detectors coverage not being equal to or over 70%.
References to issues identified by stakeholders: SRG 10

Issue 6-7. Voice communication systems
Voice communication systems are not required in the New Zealand Building Code.
These systems allow building management or the fire service to direct evacuation appropriate for an event. This is usually applied to buildings with high occupant loads, high-rise buildings, stadia and other buildings with complex evacuation procedures.
References to other Building Codes: NCC 32, WB 18, WB 19

Issue 6-8. Maximum sound levels
There are no limits on the maximum level of sound by fire alarm systems in F7 Warning Systems.

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[117] Refer to Appendix C for a comparison to international building codes.

Excessive volume of alarms can affect people with sensory sensitivities and excessive sound pressure levels can be disorienting for anyone evacuating a building.
Excessive volume of alarms can cause issues with voice communications systems and can be limit the instructions heard in manage evacuation situations.
References to other Building Codes: NBCC 3, NBCC 9
References to issues identified by stakeholders: STF 15

Issue 6-9. Warning systems for lifts
Where emergency lifts are provided, warning systems are required to alert on the use of the lift and provide other information to occupants and firefighters.
There are no requirements for emergency lifts in the New Zealand Building Code and, for this reason there are no requirements for alerting on their use.
References to other Building Codes: NCC 28, NCC 31

Issue 6-10. Fire alarm monitoring
Connecting fire alarm systems to the fire service or a private monitoring company is not clearly stated on a compliance schedule.
Through the normal operation of a building, this connection may be dropped and not picked up as part of regular checks of the fire alarm system.
References to issues identified by stakeholders: SRG 5

D.6.4 Automatic suppression systems such as sprinklers

FENZ reported on three separate fires in 2019 demonstrating the effectiveness of fire alarms and sprinkler systems[119]. This includes instances when sprinklers activated and controlled the fire as well as an instance when a small smouldering fire did not activate the sprinkler system and only the smoke detector was activated.

Internationally, where buildings have higher risks, these are often protected with sprinklers. But there are differences in other building codes when these requirements may be needed.

Care occupancies, such as retirement villages or hospitals, are most likely to be protected with sprinklers[120] Many jurisdictions required the retroactive installation of sprinklers to existing buildings following significant fire events[121]. Some jurisdictions also require sprinklers for all residential buildings.

There are no specific provisions within the New Zealand Building Code that considers other types of suppression other than fire sprinkler systems. There are other types of systems that may be more suitable for the specific hazards.

We have identified 3 issues related to sprinkler systems and other types of automatic suppression systems.

Issue 6-11. Sprinkler systems
There are no explicit statements or enabling provisions in the New Zealand Building Code on the design of sprinkler systems[122.] The design requirements of these system are contained in New Zealand standards and considers things like:

- fuel load
- building use
- sprinkler design areas and the number of sprinkler heads that may be activated
- water supply including capacity, flow and pressure

[119] Refer to Appendix B.1 and historical fire event HFE 37.
[120] Refer to Appendix C for a comparison of international building codes.
[121] Refer to Appendix B.1 and historical fire events HFE 42 and 44 for New Zealand fires events resulting in sprinklers for hospitals and care homes. Refer to HFE 27, 29, 31, 47, HFE 48 for fire events in Australia, Canada, and United States.
[122] Although sprinkler performance is not specified in the Building Code, the Fire and Emergency New Zealand (Fire Safety, Evacuation Procedures, and Evacuation Schemes) Regulations 2018 contain prescriptive requirements for sprinkler standards that must be complied with.

References to other Building Codes: WB 45, WB 46, WB 47

Issue 6-12. Alternate automatic suppression systems
There are no specific provisions within the New Zealand Building Code that considers other types of suppression other than fire sprinkler systems. There are other types of systems that may be more suitable for than water for the specific hazards such as:

- Automatic suppression systems which may be water-mist, chemical or gaseous suppression systems. Currently these are difficult to design and install in New Zealand, primarily through lack of knowledge or understanding of these systems. These systems may be used as part of special hazard protection in storage warehouses, data centres, or cold storage warehouses.
- Specific sprinkler design for automated storage retrieval systems and electric vehicles as a conventional sprinkler design will not be effective.

Where the fires cannot be effectively suppressed, this can challenge the fire resistance construction and structural members and put occupants at an increased risk of injury or death.
References to other Building Codes: WB 51, WB 52
References to issues identified by stakeholders: SRG 10, STM 17, STM 20

Issue 6-13. Enhanced water supply
The New Zealand sprinkler standard NZS 4541 includes requirements for when an enhanced water supply is required for a building based on the risk of the building (primarily related to its height and use).
This is the type of requirement that should be placed in a higher level of regulation.
References to issues identified by stakeholders: SRG 5

D.6.5 Smoke control systems

Smoke control systems include exhaust systems and pressurisation systems which can limit or stop the spread of smoke in a building.

Other codes have requirements for smoke control systems (including smoke venting or air pressurisation) to help evacuation and firefighters in certain buildings. In the UK, the approved documents do not require these features but has other concessions where smoke control systems are installed[123].

The New Zealand Building Code has limited provisions in the regulations, acceptable solutions, and verification methods for these systems. This leaves a large gap in what the expected level of performance of these systems is intended to be. Code clause C3.8 contains requirements for large unsprinklered firecells and is intended to require smoke control for these buildings. However, it is not worded very clearly[124].

Issue 6-14. Smoke control systems
There are no explicit provisions for the design or commissioning of smoke control or smoke management systems. These systems may be required to comply with clauses C3 to C6. Where these systems are present, the performance criteria must consider:

- the use of passive smoke vents and 'natural smoke' control in atriums or warehouses
- the tenability criteria and limits on the spread of smoke
- design fires and the mass of smoke that may be produced
- smoke exhaust rates and the rate of make-up air
- pressure differentials
- climatic considerations including stack effect in taller buildings
- interaction of the smoke plume with sprinklers
- smoke exhaust controls and fire service operation of these

[123] Refer to Appendix C for a comparison to international building codes.
[124] Refer to Appendix B.2 and report R019.

- Shutdown of air handling and mechanical ventilation systems

References to other Building Codes: ICC 28, ICC 35, WB 8, WB 9, WB 10, WB 11, WB 12, WB 13, WB 14, WB 15, WB 16
References to issues identified by stakeholders: SRG 5

D.6.6 Interactions with other regulations

We have identified 3 issues related to fire safety systems and compliance with other parts of the Building Code and other regulations.

Issue 6-15. Specified system descriptions
Compliance schedules and the specified system regulations are not set up to recognise or document all aspects of fire safety systems that may be incorporated into an alternative solution.
This limits the application of performance-based design and means that some of these features may not be maintained over the life of the building.
A lack of maintenance can increase the fire risk to the building and its occupants.
Specific items that are not captured well in a compliance schedule include fire curtains, smoke curtains, fire separations, corrosion of fire rated steel, and signage for different systems as required by fire safety system standards.
References to issues identified by stakeholders: SRG 1, SRG 2, SRG 5, SRG 8, STM 1

Issue 6-16. Interfaces with other parts of the Building Code
Fire safety systems need to be integrated and coordinated with other parts of a building. Fire safety systems themselves must all be integrated together so that fire alarms, sprinkler systems, and smoke control systems all respond as expected.
Currently, there are limited links from C1-C6 to other many other parts of the Building Code that relate to these systems. This includes:

- Lifts for both evacuation, and firefighter use – D2 Mechanical installations for access
- Smoke exhaust systems and mechanical shutdowns – G4 Ventilation
- Water based suppression – G12 Water supplies
- Other mechanical and electrical systems – G Services and facilities

References to other Building Codes: WB 63, WB 65, WB 66
References to issues identified by stakeholders: SRG 1, SRG 12, STM 8, STF 1, STF 2, STF 4

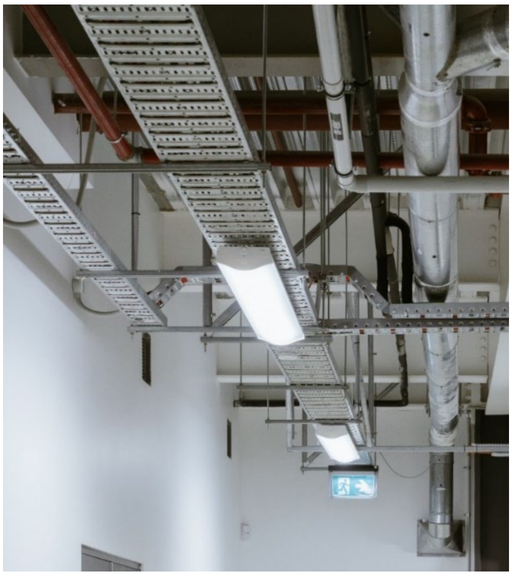

Figure 14. Building services including fire safety systems in a corridor

Issue 6-17. Alignment with evacuation procedures
Fire safety systems need to be integrated and coordinated with evacuation procedures in a building.
Compliance with the Building Code or the Fire and Emergency (Evacuation Scheme) Regulations 2018 may require a specific sequenced operation of the fire alarm system or may contain conflicts with the design of the fire alarm system.
Currently, the evacuation scheme regulations are not referenced or accounted for in the Building Code which may leave gaps in how the building is designed.
References to issues identified by stakeholders: SRG 5**,** SRG 8**,** SRG 10

D.6.7 Systems in specific buildings

Issue 6-18. Design guides for Government buildings
The Government Property Group, Ministry of Education, Health NZ and Department of Corrections have their own guides for designing government owned offices, schools, hospitals, and prisons that exceed the minimum requirements of the Building Code.
These are not deemed-to-comply documents published by MBIE. This can create confusion on what the required minimum level of fire safety is for these buildings.
References to issues identified by stakeholders: STM 12 STM 19, STF 1, STF 2

Issue 6-19. School buildings
School buildings are becoming more complex and larger with bigger firecells, internal atriums, and a shift from light weight timber to steel and concrete construction.
This requires further consideration of their design in the acceptable solutions as these features may not be adequately addressed and require alternative solutions to demonstrate compliance.
References to issues identified by stakeholders: STM 19

Issue 6-20. Prisons
The Department of Corrections prison design guide contains measures for the fire safety for the design of prisons as an alternative solution.
This design guide was previously published by MBIE as a guidance document under section 175 of the Building Act.
In its current state, there are building consent authorities who seek compliance for prisons using this guide. But its application to existing buildings is difficult as these prisonss do not (fully) comply with the guide and retrofits would be costly. This includes the installation of sprinklers in prison cells. Sprinkler heads in prison cells risk being tampered with and make it challenging for inspections and maintaining the building warrant of fitness of the systems.
There are also situations where the false activation of the system will alert FENZ which has led to several unnecessary callouts. Preference is for fire service notification by a manual call point.
There are international examples where smoke detection and control are provided in prisons instead of sprinklers. This smoke detection is preferably installed inside the mechanical ventilation system to reduce the risk of tampering.
References to issues identified by stakeholders: STM 12, STF 14

Issue 6-21. Exit sign locations
Acceptable Solution F8/AS1 includes provisions for the location of exit signs in buildings.
Paragraph 4.1.1 is currently written to require a potential excessive number of exit signs noting that signs shall be clearly visible and shall be located 'At each point in the open path where a door giving access to a final exit or an exitway is not visible in normal use'.
This can be taken to mean that every bathroom, storeroom, meeting room, and similar should get a sign.
Normal current industry practise does not provide signs in these locations where the way out is very clear. This meets the intent of the Building Code but not this requirement.
References to issues identified by stakeholders: SRG 10

D.7 Evacuation and means of escape

If a building is on fire, occupants should be able to get to a place where the fire will not affect them, usually outside, quickly and without mishap. In most cases this includes having at least 2 ways out from any location in the building so that when one way is blocked by fire, there is another way to get out. These evacuation or escape routes must be:

- free of obstacles
- wide enough for the number of people who use them, and
- limited in length.

Occupants must be made aware of which way to go and be protected from the effects of fire getting to safety.

D.7.1 Effective evacuation is necessary to prevent injuries and deaths

Inadequate means of escape in a building during a fire can result in large numbers of injuries and fatalities, as historical fires have shown[125]. Common problems were a lack of exits, blocked exits, overcrowding, confusing layouts, lack of proper exit signs, and inadequate protection of exits. In these situations, occupants may become trapped in the building.

Some buildings are required to have evacuation schemes under the FENZ Act and rehearsed fire drills where people may be more familiar of where to go and what to do. Evacuation can be more challenging for example where people are unfamiliar with the building (e.g., public spaces), there are large crowds, people are impaired, confined to bed, or restrained. Ideally, when the fire service arrives, all occupants are safe, and firefighters can direct all their resource on preventing further spread of the fire not on rescue operations.

The New Zealand Building Code does not specify the number of exits that are required from a building or their design in the code clauses. Code clause C4 contains performance criteria and statements for the assessment of tenability and visibility conditions of the escape route. These levels of carbon monoxide, heat and visibility are not tied to any other parts of the building code such as the performance of lining materials which give off smoke and toxic gases or the emergency lighting provisions[126].

These features in the Building Code are unique to New Zealand. Other countries have significantly more requirements around the specification of exits and their design on the risks if the escape routes are inadequate for the building[127]. Previous reviews questioned whether the type of evacuation assessment used in the New Zealand Building Code reflected actual evacuations in the population at large[128] and recommended that a sensitivity analysis be undertaken for assessing evacuation from buildings[129].

We identified 5 issues relevant to the means of escape features provided in buildings.

Issue 7-1. Exits and escape routes
There are no clear requirements for when exits or escape routes are required in the New Zealand Building Code.
These are required in a round-about way to comply with C4 Movement to place of safety.
Provisions are found within the acceptable solutions.

[125] Refer to Appendix B.1 and historical fire events 6, 7, 25, 31, 48, 50, 51, 52, 53, 54, 55, 57, 58, 63, 84, and 98.
[126] Refer to Appendix B.2 and report R009.
[127] Refer to Appendix C for a comparison of international building codes.
[128] Refer to Appendix B.2 and report R011.
[129] Refer to Appendix B.2 and report R008.

This creates uncertainty on how means of escape features are to perform for alternative solutions or designs under Verification Method C/VM2. Exits, means of escape, and safe places must be appropriate for:

- the travel distance
- the number, mobility, and other characteristics of occupants
- the function or use of the building
- the height of the building
- the fire safety features provided in the building
- whether the escape route is from above or below ground level
- the number of exits required in case one is compromised
- the distance between exits in case one is compromised
- the discharge of exits onto a public thoroughfare
- the maximum length of dead-ends where occupants cannot exit in two directions
- the fire load and potential fire hazards
- other fire safety systems present in a building and
- firefighting intervention.

References to other Building Codes: NCC 11, NCC 13, NCC 25, ICC 2, WB 23, WB 25, WB 26, WB 27, WB 28

Issue 7-2. Design of escape routes

There are no clear requirements for supporting the design of escape routes in the Building Code clauses or Verification Method C/VM2.

These provisions are found within the acceptable solutions and commentary for C/VM2. This creates uncertainty on how means of escape features are to perform for alternative solutions or design under C/VM2. Consideration is required for:

- obstructions along paths
- different types of building occupants, such as older people or people with disabilities
- ease of use and ensuring doors and escape features are readily openable
- the protection of occupants in horizontal and vertical safe paths including the protection of corridors, stair shafts, and doors
- safety glazing
- door swings
- exit hardware
- locks
- exit discharge locations
- door push bar and exit hardware for crowd situations

References to other Building Codes: NCC 12, ICC 3, ICC 4, ICC 5, WB 20, WB 32, WB 33, WB 34

References to issues identified by stakeholders: STF 5

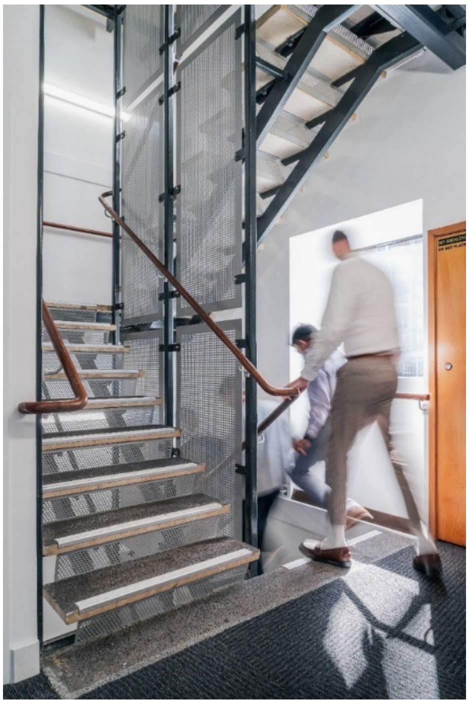

Figure 15. Evacuation through a stairwell

Issue 7-3. D1 Access requirements
Means of escape features and accessible egress needs have to be integrated and coordinated with other parts of a building.
Currently, there are limited links between C4 Movement to place of safety and D1 Access. There are provisions within the acceptable solutions that form these links.
References to other Building Codes: WB 63, WB 67
References to issues identified by stakeholders: SRG 5, SRG 10

Issue 7-4. Toxic gases during evacuation
C3 Fire affecting areas beyond the fire source does not consider the toxic gases that are a by-product of combustion of interior surface finishes, new technologies or hazardous substances.
At the same time, C4 Movement to place of safety does not consider the impact of toxic gases other than carbon monoxide on the evacuation of people.
References to other Building Codes: ICC 23
References to issues identified by stakeholders: SRG 1, STF 16, STF 19

Issue 7-5. Wayfinding
There are no requirements for wayfinding in large buildings.
Wayfinding measures would be in addition to exit signage and emergency lighting and include additional means for providing information through signage, maps, message boards, audio clues, and layouts to assist with evacuation.
This includes simple measures to ensure doors, handles, escape routes, and exits are obvious in a building. These can also support evacuation for people with visual or auditory disabilities.
This can also be important in buildings with large crowds where English may not be the first language (such as airports).
References to other Building Codes: WB 35
References to issues identified by stakeholders: SRG 5, STF 3, STF 18

D.7.2 Means of escape features for different buildings and different types of occupants

Means of escape features should be designed for people of all abilities and for different building uses.

Those requiring assistance in evacuation are exposed to higher risks as it may take longer to evacuate, and they may have to wait until the fire service responds to assist[130]. The Building Code does not provide for evacuation for different building users.

Lifts for evacuation may be more appropriate in tall buildings, hospitals, and care facilities where using stairwells to evacuate a building may be difficult. This is included in building codes in Australia and the UK. But there are no provisions to require the use of lifts in emergencies in the New Zealand Building Code and there are requirements that make it difficult to use lifts.

Investigations into the collapse of the World Trade Centre provided several recommendations for a re-think in the way that escape routes in buildings including the use of lifts, the diversity and placement of exits, and other wayfinding and communication measures[131].

We have identified 10 issues related to the means of escape features provided for people at risk.

Issue 7-6. People of all abilities
Means of escape features should be designed for people of all abilities for different building uses so that everyone can maintain their independence in evacuation.
Those requiring assistance in evacuation are exposed to higher risks during a fire emergency as it may take longer to evacuate them if they may have to wait until the fire service responds.
This is specific to clause C4 Movement to a place of safety and clauses C4.3 and C4.4. It also has direct flow-on effects to assessing the movement of people in C/VM2 such as Paragraph 3.2.4 where only one movement speed for average adults is specified for all situations.
Additional considerations are required for different building types and the range of occupants. The additional considerations are:

- those in health care facilities and medical facilities
- the number, mobility, and other characteristics of occupants
- those occupants who are sleeping when the alarm is raised
- the function or use of the building
- the size and layout of the building
- the presence of fire safety systems
- people with disabilities
- people in detention facilities.

References to other Building Codes: NCC 5, NCC 6, ICC 1, ICC 22, WB 29
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 10, SRG 12, STM 1, STM 10, STM 19, STF 3

Issue 7-7. Evacuation lifts
There are no provisions to require the use of lifts in emergencies in the New Zealand Building Code. This includes the use of lifts:

- for self-evacuation as stairs may be quite long and tiring in tall building or in hospitals and care facilities
- for those with a disability or injury and who cannot use the stairs,
- to accommodate stretchers
- by the fire service or other emergency personnel

Both Acceptable Solutions D2/AS2 and F8/AS1 contain provisions for signs to direct occupants not to use lifts in a fire. For buildings where evacuation lifts are provided, the type, number, and location of evacuation lifts should be appropriate for the:

- travel distance to the lift
- number, mobility, and characteristics of occupants
- function or use of the building

[130] Refer to Appendix B.1 and historical fire event HFE 90.
[131] Refer to Appendix B.1 and historical fire event HFE 88.

- number of storeys served by the lift
- fire safety systems installed in the building
- waiting time, travel time, and capacity of the lift
- reliability and availability of the lift, and
- emergency procedures and evacuation scheme for the building.

References to other Building Codes: NCC 14, NCC 26, NCC 27, NCC 29, NCC 30, WB 31
References to issues identified by stakeholders: SRG 5, SRG 10, STM 5, STM 9, STF 18

Issue 7-8. Fractional effective doses

The performance criteria in clause C4.3 (fractional effective doses) are not appropriate for all building occupants.

These criteria reflect an acceptable level for average populations. Specific consideration may be required for buildings such as hospitals, daycares, care facilities, certain types of accommodation buildings and similar.

References to issues identified by stakeholders: SRG 1, SRG 8, SRG 10, STM 5

Issue 7-9. Evacuation from sprinklered buildings

Clause C4.4 contains an exemption for means of escape requirements for when there are less than 1000 people and the firecell is sprinklered. But this threshold is same for all types of buildings.

This clause does not consider:

- the type of building
- the layout of evacuation routes
- the type of occupants expected in the building
- how the occupants are protected from the fire, and
- who may be exposed to the fire and how it is to be determined.

This has flow on effects to the fire modelling rules used in Verification Method C/VM2. The lack of clarity means that buildings are being designed to address low probability theoretical problems rather than the typical problems normally faced in a building. Specific concerns exist for:

- defining ‘exposure to fire’ and how to count the occupants who may be exposed
- whether the requirements apply to normally unoccupied spaces that are used for evacuation (such as safe paths and stairwells)
- whether the occupant limit applies to the people in the space or the number of people for an escape route

References to issues identified by stakeholders: SRG 1, SRG 5, SRG 10, STM 7

Issue 7-10. Accessible routes

Clause D1 Access generally only requires a single accessible route to be provided in a building.

This route would also support evacuation for people with disabilities in a fire. But there is limited consideration in the Building Code if this route is blocked by fire and no requirement to provide an alternate accessible route out of a building.

Specific considerations are required to remove barriers such as:

- multiple heavy swinging doors
- raised thresholds at doors and entrances
- narrow doors, corridors, or exterior walkways that are not wide enough to cater for a wheelchair
- small door handles that are difficult to grip
- low contrast carpet or stairwell floor coverings that may make navigating difficult for the visually impaired or others in smoke filled conditions

References to issues identified by stakeholders: STM 10, STF 3, STF 18

Issue 7-11. Phased evacuation

The scope of Verification Method C/VM2 and Acceptable Solution C/AS2 is unnecessarily limited.

Many common building types and uses (e.g. buildings which use phased evacuation procedures for more effective evacuation) are either explicitly excluded, or do not fit within the design constraints of these documents.

This means that many common building designs are required to use an alternative solution compliance pathway. This creates additional time and cost to achieve Building Consent and creates a lot of risk for building developers and project teams.
This negatively impacts the sector as whole and is a barrier to achieving an efficient and effective building consenting system in New Zealand.
References to issues identified by stakeholders: SRG 10

Issue 7-12. Hospitals
There have been significant issues and delays with the consenting of new hospitals due to perceived weaknesses in the Building Code requirements for these facilities.
Building Consent Authorities have been reluctant to approve designs as alternative solutions and FENZ have been reluctant to approve evacuation schemes.
Modern hospitals are also accommodating more patients and staff in small areas which increases the life safety risks and requires further consideration to enable efficient evacuation.
Further consideration is required in the Building Code for how hospitals and other buildings with managed or complex evacuation procedures are designed.
References to issues identified by stakeholders: STM 5

Issue 7-13. Places of safety
The requirements for places of safety are unclear in the Building Code and designs may result in conflicts with requirements of the Fire and Emergency (Evacuation Scheme) Regulations 2018.
The evacuation scheme regulations are not referenced or accounted for in the Building Code. This leads to situations where a building consent is held up due to concern about evacuation scheme details and compliance with evacuation regulations.
References to issues identified by stakeholders: SRG 5, SRG 8, SRG 10

Issue 7-14. Refuge areas
There are no specific requirements in the New Zealand Building Code for when a place of refuge or a horizontal exit is required.
It is not clear in the Acceptable Solution C/AS2 can be used to design a refuge area or an internal place of safety. These areas intended for occupants to shelter for an undetermined period before evacuating to a safe place. These occupants typically include those who cannot easily move to a safe place on their own.
This means that these areas require more robust protection. Inadequacies in internal places of safety can lead to problems when the time comes to get the associated evacuation scheme approved.
Consideration is required for the abilities of occupants and height of buildings. Horizontal exits are often required for hospitals. There are no clear requirements for these situations.
References to other Building Codes: WB 21, WB 22, WB 30
References to issues identified by stakeholders: SRG 5, STM 19

Issue 7-15. . Exit from a place of safety
The Building Code requirements in clause C4 Movement to place of safety and the Verification Method C/VM2 permit designs that allow people to exit from a place of safety into a compartment on fire.
This type of design does not generally align with current knowledge on human behaviour in fire as occupants are unlikely to evacuate into a smoke-filled room.
This is specific for buildings that are sprinklered when the exemption in clause C4.4 is applied to the building design. An exemption for sprinklered buildings may need to be included in another manner to better reflect the real-world circumstances.
References to issues identified by stakeholders: SRG 5

D.7.3 Security features and doors in escape routes

Doors can cause bottlenecks in the evacuation of people from a building. Other access controls in buildings such as locked doors and other security features can result in deaths in fire when occupants are unable to get out of the building[132]. But many buildings need security features as part of their operation (e.g. police stations, courts, and government offices). There are competing objectives between security measures for a building and provisions for means of escape such as access control, doors, and door locks. We have identified 5 issues related to these features.

Issue 7-16. Security features

There are competing objectives between the security features of a building and provisions for means of escape. Door handle heights, door locks, access control, speed gates, and fog cannons may delay evacuation and there are no clear requirements in the Building Code for how security systems are to function in relation to fire safety.

The Building Code does not state how much the occupants can be expected to do themselves to get out of the building, such as unlocking doors manually. Determination 2020/026 and the sequent District Court appeal found that there is limited consideration for human agency for in the Building Code.

There is specific concern for childcare facilities, police stations, and prisons where complying with the fire safety requirements can create larger security risks.

References to issues identified by stakeholders: SRG 5, SRG 10, STM 2, STM 7, STM 12, STM 19, STF 15, STF 20

Figure 16. Speed gate access controls requiring a card

Issue 7-17. Door widths

The requirements for door widths need to balance requirements for normal use, emergency response and evacuation, and accessibility.

Large widths can create challenges opening or closing in normal operations. For example, hotels and apartments in Acceptable Solution C/AS2 require an 875 mm clear width equating to a 950 mm wide fire door leaf. Typically, an 810 mm leaf would be more suitable while maintaining requirements for accessibility.

References to issues identified by stakeholders: SRG 12

Issue 7-18. Push bar door hardware

In Acceptable Solution C/AS2, it is often unclear when features like panic push bar door hardware is required. C/AS2 3.15.12 requires panic fastenings to retail areas with over 500 people and crowd activities over 100 people. The 2 numbers are significantly different and one could argue that retail areas are generally also considered to be crowd activities.

The requirements are based on the number of occupants but it is unclear if this applies to the number of people in a space or the number of people who may exit through a door. It is also unclear what is required if more doors above the minimum number are provided.

References to issues identified by stakeholders: SRG 10, STM 7

[132] Refer to Appendix B.1 and historical fire events HFE 24, 25, 42, 45, 46, 55, and 84.

Issue 7-19. Dual swing doors
Doors on evacuation routes must swing in the direction of escape: outwards. If there are less than 50 occupants expected to come through the door, the door may swing inward.
In Acceptable Solution C/AS2 Paragraph 3.15.3 where egress is required in both directions through a door, this must be a double swing door. It must still be a double swing door even if less than 50 occupants are expected from one side.
References to issues identified by stakeholders: SRG 10

Issue 7-20. Door forces
There are conflicting requirements in Acceptable Solution C/AS2 on the force needed to unlatch, set in motion, and fully open doors.
Paragraphs 3.15.1 and 3.15.13 specify the force of one or two hands for these actions.
This can lead to inconsistent interpretations of what is expected for different occupants in different buildings.
References to issues identified by stakeholders: SRG 3

D.7.4 Interaction with other fire safety systems

We identified 3 issues related to the interaction of means of escape features and other fire safety systems.

Issue 7-21. Interaction with F7 Warning Systems and F8 Signs
Clause C4 Movement to place of safety references clause F6 Visibility in escape routes but not F7 Warning Systems or F8 Signs. F7 and F8 are also vital for ensuring appropriate systems to notify people and allow them to escape a building.
References to issues identified by stakeholders: SRG 1

Issue 7-22. Vision obscured by smoke
Clause C4 Movement to place of safety references clause F6 Visibility in escape routes as well as requirements to maintain visibility within a space. But F6 only contains measures for when the main lighting fails and does not contain measures for when vision is obscured by smoke.
This leaves a gap where buildings are assessed through computer modelling of the fire and evacuation as designers can specify a level of lighting for occupants to evacuate the building that is not reflected in the design of the building.
References to issues identified by stakeholders: SRG 5

Issue 7-23. Maintenance and inspection of specified systems
The building warrant of fitness scheme does not include checks for many aspects of the building design that affect the means of escape from fire.
This includes items such as surface finishes, areas of refuge, and accessible routes.
Means of escape features for those with disabilities may not functionally comply in existing buildings.
Accessibility features are not included as part of a building warrant of fitness. There is no direct consideration on how these features are maintained in the building regulatory system.
References to issues identified by stakeholders: SRG 10, STM 10

D.7.5 Number of occupants

The number of occupants in a space generally dictates many of the means of escape features in a building.

Large crowds can also be challenging. Fires and other emergencies can result in people being trampled or crushed where there are insufficient exits from a building[133].

We have identified 4 issues related to the occupant loads and number of people in a building.

Issue 7-24. Occupant load densities
Occupant load densities provided in Acceptable Solution C/AS2 and Verification Method C/VM2 may no longer be appropriate for modern office buildings or mixed working environments.

[133] Refer to Appendix B.1 and historical fire event HFE 55 and 57.

The occupant load is used as a threshold for determining when certain fire safety features are to be provided and informs the design of escape routes from a building.

If the design occupant load is too low, there is an increased risk to the safety of all occupants in a building. But also, if the design occupant load is too high, this may put an unnecessary restriction on the building owners.

References to issues identified by stakeholders: SRG 10, STM 1, STF 1, STF 2

Issue 7-25. Definition of crowd spaces

The building regulatory system contains multiple ways to define a building's use and these often overlap or leave gaps in the classification of buildings.

There are provisions within the acceptable solutions that refer to crowd and care spaces, but these terms are not well defined.

References to issues identified by stakeholders: SRG 10

Issue 7-26. Very large crowds

There are no clear requirements for means of escape features for very large crowds in the New Zealand Building Code.

Specific concern exists for sporting events, stadia, concerts, or temporary events structures (such as marquees).

Very large crowd gatherings require specific considerations on the movement of people to make them operate efficiently and prevent crowd-crush types of incidences.

References to issues identified by stakeholders: SRG 1, SRG 8, STF 16, STF 19

Issue 7-27. Intermittent drops in tenability

The performance criteria in clause C4.3 (fractional effective doses and visibility) do not allow for intermittent drops in visibility or situations where visibility is reduced but then restored through the use of smoke control systems.

This can create overly complicated design constraints where the opening of a door into a safe path does not represent a significant hazard to the occupants yet may be interpreted as a failure to meet the performance criteria.

References to issues identified by stakeholders: SRG 1, SRG 5

Figure 17. Modern office spaces with casual seating

D.7.6 Means of escape in specific circumstances

We have identified 7 other issues related to means of escape in specific buildings or situations.

Issue 7-28. Means of escape during construction
There are no considerations for evacuation and means of escape during construction, demolition, or alteration of a building.
This impacts both occupants and construction personnel, and responding firefighters.
In some cases, a building may be issued with a certificate for public use but there are no specific requirements in the Building Code for how access should be provided or maintained during construction.
References to other Building Codes: NBCC 5

Issue 7-29. Means of escape in alpine regions
There are no requirements to consider evacuation and means of escape in alpine regions. The build-up of snow and ice can impact exterior escape routes or prevent exterior doors from freely opening in an emergency.
References to other Building Codes: NCC 37, NCC 38, NCC 47
References to issues identified by stakeholders: SRG 1, SRG 8

Issue 7-30. Interaction of firefighters and occupants
There is no provision for means of escape features to consider the interaction of occupants evacuating and firefighters entering a building at the same time.
This is a more significant problem for large crowds, tall buildings, or hospital/care settings where the evacuation may take longer.
Firefighters may have difficulty travelling to the fire floor in congested stairwells and may have limit space available to stage a response in a stairwell.
Standard operating procedures for firefighters may not be compatible with the Building Code requirements.
This is also a problem in prisons where safety procedures require higher security prisoners be evacuated before firefighters respond to ensure secure and separate access routes are provided for firefighters in buildings.
References to other Building Codes: ICC 49
References to issues identified by stakeholders: STF 16

Issue 7-31. Hot surfaces
There is no specific requirement in C1-C6 to limit contact with hot surfaces. This can apply to components in fire rated systems such as doors and windows.
There are temperature limiting criteria for fire resistance rating test standards but no specific enabling provisions in the New Zealand Building Code.
References to other Building Codes: NBCC 8

Issue 7-32. Robustness check for sleeping occupancies
The use of the Verification Method C/VM2 Robustness check scenario is unclear for single vertical escape routes.
The scenario description clearly states that this scenario is not applicable when there are less than 50 people in a sleeping occupancy (neither detained or undergoing treatment or care). But further down the section it appears that robustness check applies to sprinklered sleeping occupancies regardless of the number of occupants served by a single vertical escape route.
This can have a significant impact on the architectural and fire design as typically a smoke and fire rated lobby preceding the stair or a stair pressurisation system will need to be provided if visibility within the stair is required to be considered.
References to issues identified by stakeholders: SRG 10

Issue 7-33. Underground structures
Additional means of escape features are required for underground structures especially with large numbers of people. There are no clear requirements in the New Zealand Building Code for these situations.
References to other Building Codes: WB 61

Issue 7-34. Intermittent access to spaces
Means of escape features do not explicitly address individuals who may work on buildings such as maintenance staff or employees who require intermittent access to spaces.
Specific concerns exist for areas such as plant rooms, roofs, basements, car stackers, and similar spaces which are not deemed to be regularly occupied. It is unclear whether these spaces need to be assessed to the same level of stringency as other areas in a building.
References to issues identified by stakeholders: SRG 1**,** SRG 10

D.8 Emergency response

Firefighters can save lives and prevent losses in buildings. Many building fire safety requirements, especially those on fire spread and structural design, assume timely firefighter intervention. As buildings and fire hazards continue to evolve, so do firefighting responses and approaches.

D.8.1 Risk to firefighters

New Zealanders expect that first responders will respond to emergencies that occur in buildings to mitigate loss and stabilise the emergent situation so that recovery can begin.

Buildings need to include features that allow firefighters to do their job safely and efficiently.[134].

Evacuation routes must be protected for both the occupants in the building and firefighters who may enter.

Along with heat stress and burns, these instances illustrate some of the hazards presented to firefighters in New Zealand[135]:

- In 2006, firefighters were blocked in a smoke-filled rest home in Auckland as a door was locked with a combination lock. The combination was posted above the door but, due to the heavy smoke, it was impossible to see.
- In 2011, 3 firefighters were injured in Christchurch after part of a timber stair burnt away. The steel-framed roof in the building also partially collapsed creating a high-risk situation to the firefighters inside.
- In 2022, a fire on the roof of a warehouse created a risk of electrocution to anyone touching the roof. The building had solar panels on the roof and the fire melted the cables to the electrical isolation switches.
- A serious fire and explosion in Tamahere in 2008 left 1 firefighter dead and 7 more injured[136].

Buildings must be designed to meet the needs of first responders (who are authorised to enter by law) and must meet their reasonable expectations to be protected from injury or illness when doing so. This is one of the principles of the Building Act. This means buildings must provide safe access, egress, and other features for emergency operations, so that first responders can rescue occupants if required and put out fires effectively and efficiently. At the same time, this must consider their training and personal protective equipment and for how long protection is required in a fire event[137].

Firefighters regularly review tactics and new hazards can affect their response. Alternative energy systems such as solar panels, battery energy storage systems or electric vehicle charging areas need appropriate firefighting controls. Emerging building construction systems (e.g. mass timber) may introduce new firefighting hazards and challenges.

[134] Refer to Appendix B.1 and historical fire events 27, 72, 74, 78, 87, 88, and 93.
[135] Refer to Appendix B.1 and historical fire event HFE 21, 46, 72, 80, and 89
[136] Refer to Appendix B.1 and historical fire event HFE 69.
[137] Refer to Appendix B.2 and report R019.

Appendix D. Identified building code issues

Current Building Code requirements include some provisions for firefighting access and facilities in clause C5. In comparison to other building codes, the New Zealand Building Code offers fewer protective features for firefighters in a building.

Building Code Clause C5 also contains provisions for access for fire appliances. This clause is often misinterpreted as requiring roadways for buildings when it is better interpreted as dictating placements of main entrances. Clause C5 is limited in its application and does not apply to smaller residential buildings. Firefighting access to homes and buildings can be difficult in urban environments[138]. With increased building density and infill housing, steep lots, more street parking and traffic calming features, access can become more of a challenge. This can increase response time and impair firefighting activities, such as directing firefighting water externally on buildings or their surroundings to prevent fire spread.

If vehicles are too close or space to manoeuvre is limited, this can result in damage to the fire trucks from radiation or falling debris[139]. Building codes in the UK and Canada contain more detail on requirements for firefighting vehicle access.

In 2022, FENZ responded a fire in infill housing. The fire crews arrived within 7 minutes of being notified. However, access to the development was difficult. The driveway was 45 m long and 2.9 m wide, too narrow to fit a fire truck through. Access to the house involved firefighters marching on foot and breaking down a fence on a neighbouring property. Access to a street hydrant for firefighting was over 270 m away. The building was determined to comply with Acceptable Solution C/AS1. However, the fire destroyed the property and 3 other surrounding properties.

We have identified 2 issues related to firefighting access and protection.

Issue 8-1. Access and facilities for firefighting

Under the Fire and Emergency New Zealand Act, FENZ has a responsibility to provide fire response and suppression services.

The principles of the Building Act require reasonable provisions for buildings to facilitate emergency response. But it is unclear what is specifically expected for the firefighting response in different buildings.

Clause C3.8 of the Building Code has additional measures for large fire compartments. But requirements for different building uses, heights, or specific circumstances are not clearly stated in clause C5. There are measures in the acceptable solutions that relate to care homes and access. Considerations for specific building requirements include:

- its function or use
- fire load, fire hazards, fire intensity
- the size of the building, any compartments, and its construction, and
- any active fire safety systems installed in the building

FENZ develop codes of practice documents to perform their duties which requires various considerations for buildings.

The Building Code does not make reference to these documents and there are inconsistencies between consent applications and the needs for FENZ emergency response. This makes it difficult for firefighters to respond in some situations and makes it unclear what is expected to facilitate firefighting especially in rural locations where a response is limited. Specific concerns for firefighting access exist for:

- the steepness and gradient of hard-standings and vehicle access outside the footprint of the building.
- large warehouses and distribution centres which have high quantities of fuel and potential for hazardous substances and dangerous goods.
- large complexes considered as a single building with only one access point.
- access to a portion of a building rather than the entire extent where it is narrow or long.
- the location of internal hydrants where they cannot be safely reached and used

[138] Refer to Appendix B.1 and historical fire events HFE 15 and 21.

[139] Refer to Appendix B.1 and historical fire events HFE 65, 67, 68, 77, and 82.

- the use of combustible stairwells for both occupants and firefighters.
- access and quantity of water supplies for large combustible structures.
- access to and collapse of automated storage and retrieval systems with large racks.
- protrusions from buildings that may impede firefighting vehicle access including the use of aerial firefighting appliances.
- underground parking structures for both vehicles and personal access.

References to other Building Codes: NCC 10, ICC 45, WB 53
References to issues identified by stakeholders: SRG 5, SRG 10, STM 11, STM 17,STM 21

Issue 8-2. Protection of staging areas
There are no specific requirements in C5 to protect firefighting facilities including interior and exterior staging areas.
C5.6 only states that protection of the means of egress is required.
Some measures are provided in sprinkler and fire alarm standards but there are no enabling provisions in C5 Access and safety for firefighting operations.
Firefighters need sufficient protection from the radiation of external flames and from building collapse but these hazards and risks to be protected are not identified in the Building Code.
References to other Building Codes: ICC 50, NBCC 6
References to issues identified by stakeholders: SRG 5, SRG 10

Figure 18. Fire alarm panel, sprinklers and hydrant inlets, and internal hydrants

D.8.2 Fire and Emergency responds to other emergencies

Expectations of first responders continue to grow for other types of emergencies that can also occur in buildings. The Fire and Emergency New Zealand Act passed in 2017. This Act combined urban and rural fire services into a single, integrated fire and emergency services organisation. FENZ have to provide a wide range of services for communities, which include:

- responding to fires
- rescuing people or animals
- weather events including rain and flooding
- gas leaks and other incidents involving hazard substances
- urban search and rescue, and
- medical emergencies.

This remit has grown since the last review of the Building Code fire safety provisions. FENZ also respond to events in all stages of a buildings' life including during construction, alteration, or when they are unoccupied.

Issue 8-3. Responding to other emergencies
The provisions in C5 Access and safety for firefighting operations cover only fire and no additional considerations are given for other emergencies or emergency responses besides rescue and firefighting operations.
Other incidents requiring an emergency response include things like gas leaks, medical emergencies, intruders in a building, flooding, cyclones, weather events, or loss of power.
References to other Building Codes: ICC 9, ICC 21
References to issues identified by stakeholders: SRG 1, SRG 5, STM 11, STM 21

D.8.3 Delays due to building design can worsen outcomes

Provisions for firefighting are closely related to the requirements for evacuation and for structural fire design.

Efficient evacuation from a building and enhanced fire resistance of a building help firefighters do their jobs more effectively. At the same time, many building fire safety requirements, especially those on fire spread and structural design, assume timely firefighter intervention.

The design of the building and its fire safety systems can affect the response by firefighters[140]:

- fire alarm systems may not automatically notify firefighters
- firefighters may be blocked where there are lots of people evacuating from a building and the access and escape routes are narrow
- firefighters can have difficulty locating fire safety systems in the building
- sprinkler systems, hydrant systems, or smoke control systems in the building fail to operate.

As part of the investigation into the collapse of the World Trade Center, there were several recommendations on the access and communication required for emergency response. Other overseas codes have additional features for firefighting in buildings which helps facilitate an efficient response[141]. We have identified 5 issues related to enabling efficient access and communication.

Issue 8-4. Notification of emergency
There are no specific requirements in F7 Warning Systems to automatically notify responders to an emergency even though there are assumptions in C3 and C5 that assume firefighters respond.
Some provisions exist in the acceptable solutions and standards.
References to other Building Codes: NCC 25, NBCC 7

Issue 8-5. Command centres
There are no clear requirements in the New Zealand Building Code for emergency command centres or for firefighter access to any systems except for inlets to sprinklers and fire hydrants and fire alarm mimic panels.

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[140] Refer to Appendix B.1 and historical fire events 32, 62, 70, 75, 87, 88, 90, 96.
[141] Refer to Appendix C for comparisons to international building codes.

References to other Building Codes: WB 54, WB 56, NCC 23

Issue 8-6. Lifts in buildings
There are no specific provisions in Building Code clause C5 to require firefighting lifts in buildings.
High-rise buildings present challenges for the fire service.
References to other Building Codes: WB 55

Issue 8-7. Communication systems
There are no specific requirements in C5 Access and safety for firefighting operations for firefighters' communication systems in buildings.
Communication devices should be provided based on the complexity of the building (geometry, height, and construction) as other personal means of communication may be ineffective or unreliable in an emergency.
References to other Building Codes: ICC 52, ICC 53

Issue 8-8. Weather effects on response
There are no considerations for the impact of regional weather conditions on the performance of fire safety systems or access to buildings for firefighting.
In cold climates, temperature changes can impact the behaviour of venting smoke or increase the stack effect in tall buildings. At the same time, sprinkler systems require freeze protection in colder climates and means of escape or access routes can be blocked by snow or ice.
References to other Building Codes: NCC 34, NCC 35, NCC 36, NCC 39, NCC 48, NCC 52

D.8.4 Access to water supplies and suppression equipment

There is limited consideration for the provision of firefighting water supplies in the New Zealand Building Code. Firefighting water supply to a property is typically a service provided by local government in built-up areas.

Some district plans include requirements for firefighting water supply as part of obtaining a resource consent.

While the Building Code cannot require the provision of services outside of the scope of the Building Act, it can consider situations where water supplies to buildings are not provided or limited and consider additional fire safety features or place limitations on acceptable building characteristics.

Other Building Code requirements already operate as a function of location and environment such as wind loads, snow loads, seismic risk that may be present for structural design.

There are also no requirements in the New Zealand Building Code for hand-held suppression systems such as extinguishers or hose reels to be provided in buildings.

Other international building codes include additional requirements for:

- the water supplies necessary for buildings (the UK, Canada)
- firefighting equipment including hydrant systems, pumps, and manual firefighting equipment such as hose reels or fire extinguishers (Australia, the UK, Canada).

We have identified this as 2 separate issues.

Issue 8-9. Extinguishers
There are no explicit requirements in the New Zealand Building Code that address handheld or manual suppression for occupants or firefighters including extinguishers or hose reels.
While there are standards for these, they are not referenced in the New Zealand Building Code.
Considerations are required for where these should be located, what type of extinguishers/extinguishing agent should be provided for the occupancy or hazards and the means to protect or safeguard through cabinets or security features.
Extinguishers may be vital for areas like hospital operating theatres where extinguishing a fire quickly is more desired rather than evacuating a room. A large portion of fires can be extinguished at an early stage using hand-held extinguishers.

References to other Building Codes: NCC 17, NCC 18, NCC 19, ICC 51, WB 36, WB 40, WB 43
References to issues identified by stakeholders: SRG 1

Issue 8-10. Water supplies
There is limited consideration for the source or proximity of firefighting water supplies in the New Zealand Building Code and no consideration if water is not available.
For example, the Building Code requires building firefighting inlets to be within 20 m of a fire service attendance point but there is no requirement for the water supply to be in the vicinity of the attendance point. Where there is a poor water supply in the public water mains or the mains do not exist, it is often difficult and expensive to provide additional supplies of firefighting water through storage tanks.
It is unclear what aspects of a water supply are included under the Building Act versus other legislation and whether this is a matter for the building consent application. Also, clause C5.5 related to the means to deliver water for firefighting is unclear and may be interpreted as requiring water supply to sub-floor spaces, concealed spaces, and roofs.
While district plans generally address where firefighting water is required, there is scope within the Building Code to specify the expected performance of water supplies when they are required. This could include:

- access for control and maintenance of mechanical components and their operation
- sizing of onsite firefighting water supplies, and
- isolation to avoid failure or uncontrolled discharge.

Similar requirements for potable and non-potable water supplies are found within G12.3.7 and G12.3.8.
References to other Building Codes: NCC 55, NCC 56, NCC 57, ICC 48
References to issues identified by stakeholders: SRG 1, SRG 5, SRG 8, SRG 10, STF 16, STF 19

D.8.5 Firefighting in large buildings

The challenges of the height and size of buildings have been observed in multiple fires in New Zealand[142]. Even in Auckland in the 1870s, it was noted that the height of buildings delayed firefighters to respond effectively.

More recently, in New Zealand, the 2019 International Convention Centre fire in Auckland presented many obstacles to FENZ. The size of the building and location of the fire was at the limits of FENZ's ability to fight a fire from the outside. A single aerial appliance was available that could reach the roof of the building. Supplying firefighting water to all parts of the building was difficult and slowed down the response.

Similar experiences have been documented in fires overseas for buildings are taller than the ladders on fire trucks or aerial units can reach[143]. We have identified the complexity with large buildings as an issue.

Issue 8-11. Large buildings
Large complex buildings require specific considerations of the facilities to be provided.
C5.5 only states that a means to deliver water for firefighting is required to all parts of a building. Firefighter response generally requires simple, practical solutions that align with standard firefighting operational procedures.
This often leads to stricter descriptions of the types of facilities required. There are no specific provisions in C5 to support facilities for firefighting to be provided including:

- firefighting water supplies or access to useable water sources
- internal hydrant (standpipes) for large or tall buildings to allow firefighters to connect with hoses within the building near the fire
- hose cabinets for fire service use in a building which eliminate the need to carry hoses to use internal hydrants
- fire service connections from the outside of the building to connect to the interior hydrant systems
- fire pumps to provide the necessary pressure and flow rates for sprinklers and manual suppression at higher floors, and

[142] Refer to Appendix B.1 and historical fire events HFE 05, 65, 91, and 96.
[143] Refer to Appendix B.1 and historical fire events HFE 27 and 43.

- connections to exterior fire service hydrants.

References to other Building Codes: NCC 20, WB 37, WB 38, WB 39, WB 40, WB 41, WB 42
References to issues identified by stakeholders: STM 17

D.8.6 There are 4 other issues related to emergency response and firefighting

Issue 8-12. Response to hazardous substances
Clause C5.7 of the Building Code requires signage for firefighters around hazardous substances and processes in a building. This matter is also covered in the Health and Safety at Work (Hazardous Substances) Regulations 2017. But there is no direct connection between the Building Code and these regulations for this requirement. There is potentially a duplication of requirements between the regulations. It is also unclear which set of signage requirements ensure that firefighters have clear information about the presence of hazardous substances in a building.
References to issues identified by stakeholders: SRG 10

Issue 8-13. Firefighting during construction
There are no considerations for firefighting access during construction, demolition, or alteration of a building. Some provisions exist in specific standards to enable the progressive installation of hydrant and sprinkler systems as construction progresses. However, these are not in the mandatory Building Code clauses.
References to other Building Codes: NCC 22, NBCC 5

Issue 8-14. Fire Brigade Intervention Model
The Fire Brigade Intervention Model (FBIM) or similar publication is not referenced in the Building Code system.
It can be used to estimate the time taken for firefighters to respond to different events which can then support performance-based design. For example, clause C3.8 refers to the 'time that firefighters first apply water' but how this is determined is not specified.
References to issues identified by stakeholders: SRG 5

Issue 8-15. Length of firefighter hoses
There are no specific enabling provisions to limit the length or number of hoses required to reach the fire in the New Zealand Building Code.
This applies to both hoses run from the exterior of the building, or hoses run inside the building. There are requirements in the acceptable solutions and within the hydrant standard NZS 4520 that cover the lengths of hoses based on their standard sizing, length, and standard firefighting operational procedures.
References to other Building Codes: ICC 46, ICC 47

D.9 Structural fire safety

Structural fire safety bridges the gap between a structural design of a building and its performance in a fire. As for earthquakes, wind, or other loads, the structural supporting members in a building must be sufficient to withstand the effects of fire. To do so, structural members require sufficient fire resistance and must fulfil their function to meet the fire safety objectives of the Code.

D.9.1 The type of construction is important

At the elevated temperatures produced in a fire, materials can lose their strength and fail at lower loads than in ambient temperatures. At the same time, members can lengthen or deform which may alter load paths in the building as structural members normally in compression are put into tension or vice versa.

Different construction types may have different considerations when exposed to fire. For example, wood will burn and lose its strength but, at the same, create a char layer that can insulate and protect the unexposed wood beneath. Steel members are non-combustible but are generally thinner and susceptible to direct heating. Concrete is also non-combustible and can act as a heat sink but spalling of the concrete in a fire can expose the reinforcing steel and reduce the strength of the member overall.

There are other products on the market that are used to enhance fire resistance of the structural elements. For other specific buildings:

- while steel portal framed buildings push the tops of walls outwards as the portal frames soften and begin to collapse, most other roof structures and floors pull the exterior walls inwards as they collapse
- older brick structures tend to either remain standing as their timber floors collapse or are pulled inwards
- reinforced concrete elements often remain attached to the structure by their reinforcing steel.

Neither the performance-based requirements in the Building Code clauses nor the commonly used acceptable solutions:

- distinguish between the materials used to construct the buildings
- consider how loadbearing components could extend, bow, soften, lose strength, or fail during fire; or
- consider how those behaviours during fire could affect the performance of the building.

We have identified 2 issues related to the hazards and consequences addressed in the structural fire safety provisions.

Issue 9-1. Hazards and consequences for structural design
It is not clear what hazards and consequences are being addressed in the design for structural stability in fire. Different types of fires may result in different temperatures being applied to the structure. Some types of structures require only consideration of the maximum peak temperatures being applied where other types require consideration of the heating and cooling phases.
This cooling phase can last for a significant point in time (hours or days) and it is unclear what duration of the cooling must be considered to achieve compliance with the Building Code.
References to issues identified by stakeholders: STM 21

Issue 9-2. Methods for structural design
The methods used for structural design must be appropriate to the type of construction including considerations of the type of material.
The New Zealand Building Code clauses, acceptable solutions, and verification method for Protection from fire have limited considerations for structural stability in fire for different circumstances.
Light frame construction is inherently different to heavy steel or concrete, and both of these forms are significantly different to mass timber construction.

The methods used for one type of building may not be applicable to another type of building. This can result in both uneconomic designs when overly conservative methods are applied or designs with insufficient fire safety when incorrect methods are used.
References to other Building Codes: NCC 7
References to issues identified by stakeholders: STM 6, STM 21

D.9.2 Timber buildings

There is a desire to increase the use of timber in the built environment including structural members and framing. This includes the use of hybrid construction with timber alongside other materials.
Mass timber buildings provide additional complexities in the fire design as highlighted in the work by Timber Unlimited[144] and require further considerations in their design.
Timber buildings have unique challenges in fire such as:

- burning of exposed timber adds fuel to the fire and increases the energy released and the duration of burning.
- charring and heating of structural members reduces their capacity to support loads. The increased burning from the additional fuel can increase the rate of charring in a real fire.
- charring can continue after other fuel sources have been consumed if there is no intervention by firefighters.
- structural failure of timber elements can occur after the fire appears to be out.
- fires in mass timber buildings can re-ignite.
- additional precautions may be needed to reduce the risk on construction sites. For example, a fire in a large timber housing complex under construction in Canada lead to a dramatic helicopter rescue of a crane operator who was trapped for 2 hours while the fire burned below him.

There are limited provisions in the Building Code that explicitly address how timber can be used without compromising the fire safety of the building. Other building codes have specific measures that address combustible construction or mass timber buildings. These generally include increased fire safety features in other areas of the building design.

Issue 9-3. Timber structures
There is a need for the increased use of timber in the built environment including structural members and framing. This includes the use of hybrid construction with timber alongside other materials. There are limited provisions in the Building Code that clearly address how timber can be used without compromising the fire safety of the building. Mass timber buildings provide additional complexities in the fire design as highlighted in the work by Timber Unlimited and require further considerations in their design.
References to issues identified by stakeholders: SRG 3, SRG 5, SRG 12, STM 4, STM 15, STM 21

D.9.3 Buildings are often destroyed before they collapse

There are numerous examples of structural failure because of a fire but there are no systematic studies of the ways buildings constructed in New Zealand have behaved during and after fire. Collecting this data is often difficult. Buildings are often destroyed either by the fire or, if posing a risk to the community, knocked down by firefighters[145].

Partial collapse of the roof or walls has been observed in fires in New Zealand and overseas[146]. The 22-storey Ronan Point building in the UK had one corner collapse in almost every level in 1968[147]. This resulted in a UK regulation requiring buildings to “be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause." This regulation has been credited with the Grenfell tower

[144] Refer to Appendix B.2 and report R0
[145] Refer to Appendix B.1 and historical fire events HFE 1, 2, 3, 4, 7, 11, 20, 42, 65, and 68.
[146] Refer to Appendix B.1 and historical fire events HFE 47, 65, 72, 82, and 85.
[147] Refer to Appendix B.1 and historical fire event HFE 85.

remaining standing during its fire. Collapse of internal building elements is a concern for firefighter safety as it can affect their ability to exit a building[148]. Stairwells are a particular concern.

Many buildings that have burnt out remain standing for considerable periods while waiting for investigations, insurance settlements, and court judgements. This was the case with the One Meridian Plaza building in Philadelphia, United States. Following a fire and subsequent worry of structural collapse, the 38-storey building sat vacant for 8 years until it was eventually demolished[149]. There was extensive study into the collapse of the World Trade Centre which advanced our understanding into structural behaviour during fire[150].

Where fires have occurred in smaller, single or two-storey buildings, the consequences of collapse are generally quite limited. As the buildings get taller, the concerns increase especially where the buildings have large populations or higher importance to the community.

Factors that should be considered in the structural design are the:

- height
- Importance
- function and use of the building
- fire hazard
- proximity to other buildings
- size of the compartment
- fire service intervention, and
- evacuation time.

We have identified two issues related to design of different buildings.

Issue 9-4. Design for different circumstances
The New Zealand Building Code has limited considerations for structural stability or robustness for different circumstances.
The provisions should consider the height, importance, function and use of the building, the fire hazard, the proximity to other buildings, the size of the compartment, fire service intervention, and the evacuation time.
References to other Building Codes: NCC 3, ICC 32
References to issues identified by stakeholders: SRG 5, STM 6, STM 21

Issue 9-5. Allowable damage
Clause C6 of the Building Code does not address the maximum allowable damage that a building may experience in a fire. Small low-damage fires may result in the building being demolished and rebuilt than repaired.
References to issues identified by stakeholders: SRG 1

D.9.4 Fire safety provisions link to structural provisions in the Building Code

The Building Code covers structural performance during fire are in two separate clauses: B1—Structure and C6—Structural stability.

Clause B1 requires buildings to be capable of withstanding all physical conditions throughout their lives including fire.

C6 only applies during and after fire and has requirements that are unique, overlap with B1, and only appear in B1.

148 Refer to Appendix B.1 and historical fire events HFE 72 and 74.
149 Refer to Appendix B.1 and historical fire event HFE 87.
150 Refer to Appendix B.1 and historical fire event 88.

There are additional provisions in the acceptable solutions, verification methods, and cited standards that support compliance with these clauses.

In 2017, a review of clause C6 found it was difficult to interpret and is not clear about whether a fire engineer or structural engineer is responsible for demonstrating the building meets its requirements[151].

The alignment of C6 and B1 clauses is still an issue.

Issue 9-6. Alignment with B1 Structure
Structural performance of buildings in fire has to be coordinated with other structural provisions in the Building Code.
Clause C6 Structural Stability and clause B1 Structure both contain measures related to the structural fire safety of a building. But it is not clear how the 2 clauses of the Building Code work together.
There are some measures in the acceptable solutions, verification methods, and associated standards but these differ between the B1 and C6 clauses.
This is a sticking point for a lot of buildings due to discrepancies in the wording and the description of what is required. It is not clear if C6 is an additional set of requirements or whether satisfying C1 and C6 will achieve the objectives for B1 Structure and the performance criteria in clause B1.3.3.(i).
Specific concern exists for:

- The limit states used for the structural design of buildings in both C6 and B1.
- Post-fire stability of boundary fire walls including what is intended by the Acceptable Solutions B1/AS1 and C/AS1. Functional requirement C6.1 says “structural stability during fire” but Performance clause C6.2 says “stable during and after fire”. B1/VM1 2.2.4 also has various statements for ‘during’ the fire, and ‘after’ the fire which includes ‘until … repaired or demolished’ which is very difficult to apply.
- Importance levels used in clause A3 for fire design and AS/NZS 1170.0 are not uniform in their description of buildings for different levels.
- Seismic bracing of fire protection systems.
- The description of building elements in C6.4 versus structural members that are part of a load path.

References to other Building Codes: WB 62, WB 63, WB 64
References to issues identified by stakeholders: SRG 1, SRG 8, STM 6, STM 8, STM 21, STF 12

D.9.5 Simple design approaches focus on protecting elements

The simplest design approach involves the specification of fire resistance ratings for individual elements. This can be done using prescribed values in the acceptable solutions or basic calculations in Verification Method C/VM2.

For this approach, it is determined how long each building element could be exposed to a standard fire in each compartment, and then structural elements are sized to achieve the specified fire resistance rating. Some components may need passive fire protection to extend their exposure periods. It may be tolerable for some components to shed load or fail.

In comparison to other countries, New Zealand has notably lower fire resistance ratings specified[152].

For compliance checking, the simple design approach uses one standard fire scenario, with its duration based on both the building and how it is intended to be used.

Clause C6 applies to all structural systems in buildings. Where the fire resistance rating is too low, there is a risk of collapse of the members and collapse of the building. This has been observed recently in several car park fires overseas where the low fire resistance provided by the structure was insufficient for the fire that occurred[153]. This can be a concern where a building is designed using C/VM2. The ‘time equivalence’ method is

[151] Refer to Appendix B.2 and report R024.
[152] Refer to Appendix B.2 and report R029.
[153] Refer to Appendix B.1 and historical fire events HFE 99, 100, and 101.

often used in the wrong circumstances. It is most appropriate for use with protected steel structures located in small fire separated compartments. It is not generally suitable for assessing the integrity of fire separations or other types of construction.

Issue 9-7. Time equivalence
Verification Method C/VM2 includes a calculation method known as “time equivalence method” which is used to establish the equivalent fire resistance rating for structural members in fire testing.
This method is often used in the wrong circumstances. It is most appropriate for use with protected steel structures located in small fire separated compartments. It is not generally suitable for assessing the integrity of fire separations or other types of construction.
References to issues identified by stakeholders: STM 21

D.9.6 Structural elements work together as systems

Building elements often extend, bow, lose strength, or become consumed during a fire. These behaviours can affect other building elements, including those located long distances from the fire. The behaviours of concrete, steel and timber elements are very different and can be both beneficial and detrimental to their performance and the performance of the building.

There is no clear framework in the Building Code for how connections between members are to be considered or addressed for fire conditions. Elements tested independently may not achieve the same level of fire resistance when combined because of heating and expansion.

As previously noted, other countries generally specify a higher level of fire resistance in their prescriptive requirements. This is thought to help compensate for some of these other effects not captured in the New Zealand Building Code requirements.

Issue 9-8. Structural connections
The performance of structural connections is an important consideration for the design of a building, including when it is exposed to fire. But there is no clear framework for how connections are to be considered or addressed for fire conditions.
Elements tested independently will not achieve the same level of fire resistance when combined due to the effects of heating and expansion.
References to issues identified by stakeholders: STM 21

Issue 9-9. Consequential damage
Clause C6.1 (c) contains a functional requirement to limit consequential damage to other property. In stacked multi-storey units with different owners, this requirement would be very difficult to achieve in a fire scenario. Local heating of elements in one part of a building will cause deflections and deformations that could change the structural performance of other members supporting other property.
References to issues identified by stakeholders: STM 21

D.9.7 We have identified 3 other issues in structural fire safety

Issue 9-10. Structural fire protection in compliance schedules
Compliance schedules and the specified system regulations do not capture all aspects of fire safety that are provided for in a building.
There are currently no provisions to capture the corrosion of fire protection of structural elements. Similarly, not all fire or smoke separations are listed as specified systems. This leaves significant gaps in what may or may not be maintained over the life of a building and contributes to confusion and compliance of building fire safety.
References to issues identified by stakeholders: SRG 1

Issue 9-11. Falling objects
The cited standard NZS 3101 Concrete Structures Standard used to demonstrate compliance with clause B1 is inconsistent when describing whether it is necessary to control the likelihood of objects falling from upper floors of a multi-level building during a fire.
This applies to contents of a building on fire and parts of the building itself, such as the external façade or other non-structural elements.
The Concrete Standard appears to apply a control against concrete elements falling from a building, but there does not appear to a corresponding Building Code performance criterion, nor any reason why an element made of this material presents a higher risk or consequence than any other parts of a building.
References to issues identified by stakeholders: SRG 10

Issue 9-12. Inherent fire resistance
Some steel structural members could have an inherent structural fire resistance, but this may not achieve the prescribed fire ratings of 30 or 60 minutes.
When it is not met, this often requires additional passive fire protection which increases the cost of buildings. It is unclear when bare steel is suitable in a building without protection and whether there are certain steel members that could be deemed to comply in certain situations.
References to issues identified by stakeholders: STM 19

D.10 Buildings undergoing alterations or change of use

Buildings undergoing alterations or a change in use must comply with certain parts of the Building Code. These provisions are found in sections 112 and 115 of the Building Act. They require buildings to comply with some parts of the Building Code 'as nearly as is reasonably practicable'. It is not within the scope of this project to review these Building Act requirements. However, there are still issues in applying the Building Code provisions for fire safety to existing buildings and issues related to how building uses are assessed.

D.10.1 The different classification systems add complexity

The building regulatory system contains multiple ways to define a building's use and these often overlap or leave gaps in the classification of buildings. To comply with the fire safety provisions, the buildings' use may be defined as one of:

- seven classified uses in Building Code clause A1
- fifteen uses for determining the change in use
- seven risks groups used in the Acceptable Solutions C/AS1 and C/AS2
- three risk groups used for emergency lighting in clause F6 of the Building Code
- five importance levels in clause A3 which are similar but different to the importance levels used for structural design.

Other building codes used internationally commonly have one set of building classifications that span all requirements, not only just fire safety. These classification systems form a common language and structure for developing building code requirements. Past reviews of the Building Code and the fire safety provisions have recommended that these classification systems in the New Zealand Building be resolved as a priority[154].

The Building (Specified Systems, Change the Use, and Earthquake-prone Buildings) Regulations 2005 specify when a building goes from one use to another.

[154] Refer to Appendix B.2 and reports R018, R020, and R022.

Appendix D. Identified building code issues

Every building with its specific use must meet the Building Code requirements that ensure it will be safe, healthy, and durable when used in the way it was designed. If that use changes to one that is considered a higher risk, the building may need to be altered to support the new use and any increased hazards that comes with it.

When the classification of building is confusing, designers, owners, and councils may not agree whether a change of use has been triggered or if the building provides a suitable level of safety in the new use.

FENZ have reported on dangerous building declarations and issues where buildings have been illegally converted in use[155]. In one instance, the damage from the fire may have been mitigated if a change of use application had been processed and the building provided with additional fire safety features.

A single building may fall into several different categories of uses and these do not always have similar fire hazards. Some uses may have more strict fire safety requirements than others. The fire hazard may increase because:

- the type of work or activity carried out in the building has changed. For example, an electrical workshop has become a car spray painting workshop.
- goods now stored in the building present a greater fire hazard than the goods previously stored. For example, a building previously used for storing appliances now stores highly combustible furniture or the height of rack storage may have increased.

The risk to life safety may change because:

- there are more people in the building. For example, a building previously used as a storage warehouse changes to a bulk retail store or supermarket
- people's activities place them at increased risk. For example, a building previously used as a workplace becomes a building in which people sleep.

A significant event occurred in the United States where 36 people died in the Ghost Ship Warehouse fire[156]. This fire started in a derelict warehouse building which was being used for living spaces. There were no fire alarms, smoke alarms, or sprinklers in the building. Stairwells were makeshift construction from pallets and impeded exiting from the building. 36 people died in the fire.

The way buildings are used have also changed over time and new buildings may have different activities than before. Some of the significant gaps that have been identified are for residential buildings.

We have identified three issues around the building classification system and the use of buildings.

Issue 10-1. Issue 10-1. Multiple building classification systems
The building regulatory system contains multiple ways to define a building's use and these often overlap or leave gaps in the classification of buildings.
Some of the categories are outdated and it can be unclear where a building fits in and what fire safety features are required.
This can be even more complicated if a building undergoes a change in use. A single building may fall into several different use categories and these do not always have similar fire hazards. Some examples of where the gaps exist include:

- residential buildings – There are different requirements for buildings occupied by owners or rented as temporary accommodation in long- or short-term agreements though this may not always be considered in the design.
- residential homes with small businesses – Homes may incorporate owner operated small businesses (hair salons, accountant offices, physiotherapy) without a significant increase in the fire hazard. But it

[155] Refer to Appendix B.1 and historical fire events HFE 33, 35, and 60.
[156] Refer to Appendix B.1 and historical fire event HFE 63 – 2016 – Ghost Ship Warehouse fire.

is unclear how this is to be addressed with the current categories of buildings and whether it is a change of use to incorporate a small business. A change of use to an existing residential building can trigger substantial upgrades.

- schools and education facilities – These buildings are combined with other crowd type buildings including cinemas, restaurants, or night clubs. Occupants in a school are generally more aware of the layout of the building and participate in regular fire drills similar to office buildings than other types of crowd buildings. As schools are becoming larger and more complex, design as a crowd use may create significant unnecessary costs.

References to issues identified by stakeholders: SRG 5, SRG 10, STM 5, STM 7, STM 11, STM 19, STF 15

Issue 10-2. Duration of use

The change of use regulations and other building classifications schemes in the Building Code do not consider the duration of the use or activity in a building.

Some buildings may have incidental changes of use for short periods of time. These are applied differently by the territorial authorities which can result in difficulty meeting requirements to cover short periods of time in a new use.

References to issues identified by stakeholders: SRG 1, STM 1, STM 19, STF 15

Issue 10-3. Change in demographics

Changes in demographics are not currently considered in the change of use regulations.

The uses of buildings change over time due to shifts in demographics. A building in a new use may need to accommodate different disabilities or more disabled people or more old/young occupants.

References to issues identified by stakeholders: STM 10

D.10.2 The required level of performance for existing buildings is ambiguous

Older buildings may not comply with the current Building Code requirements. Key items that may be lacking in existing buildings are adequate escape routes, operational fire and smoke alarms, and sprinkler protection[157]. The Building Act requires that existing systems be maintained as part of the Building Warrant of Fitness scheme, however, it does not require that existing systems be upgraded.

Where there is an alteration or change of use, the building must comply as nearly as is reasonably practicable for means of escape from fire. This assessment requires an analysis of the sacrifices and benefits of achieving full compliance with the Building Code.

MBIE currently publishes guidance with recommended levels of information required for building consent applications for assessing means of escape from fire for existing buildings.

The application of the Building Act 2004 s112 and s115 when altering or changing the use of a building is inconsistent across the country. The MBIE Guidance on requesting information about altering existing buildings[158] is out of date, unclear and applied inconsistently. We have identified the uncertainty around the compliance for existing buildings as an issue.

Issue 10-4. Compliance for existing buildings

The application of the Building Act 2004 s112 and s115 when altering or changing the use of a building is inconsistent across the country. The MBIE Guidance on requesting information about altering existing buildings is out of date, unclear and applied inconsistently. Specific concerns include:

- Residential care, multi-level residential buildings, student accommodation, and building conversions as each project is assessed individually and, in some cases, upgrades that could happen for fire safety system are not required by the building consent or territorial authority. Further considerations are required for what types of systems and what upgrades provide the greatest improvements for the lowest costs.

[157] Refer to Appendix B.1 and historical fire event HFE 79 – 2019 – Municipal Building – Whangarei.
[158] Available online from https://www.building.govt.nz/building-code-compliance/c-protection-from-fire/c-clauses-c1-c6/means-of-escape

- There is no clear direction on what fire safety systems constitute a part of the means of escape from fire, and what features of those systems must be upgraded to improve safety.
- It is unclear what constitutes means of escape provisions for firefighters. For existing buildings undergoing alterations, this aspect of the means of escape may be ignored.
- The score sheet in the guidance document is poorly worded in some areas and does not clearly identify categories or scores for buildings constructed after 2012.
- The level of information expected or required for each case is not sufficiently defined, and there is inconsistency in what is accepted (or, required) for existing buildings, and when this is requested. For example, it can vary from being required before a fitout consent is issued, or as agreed as a separate building-wide exercise with a different timeframe.
- It is unclear how this line in the guidance document is to be taken: "If the building design, system and features fall entirely within the scope of one of the Acceptable Solutions" when existing buildings are not expected to fully comply with the current acceptable solutions.

References to issues identified by stakeholders: SRG 5, SRG 6, SRG 7, SRG 10, STF 19

D.10.3 Compliance schedules and maintenance of fire safety systems

Existing buildings have compliance schedules that list the fire safety systems in a building. There is often a discrepancy between what was previously consented, what the compliance schedule says, and what is in the building. These can lead to delays when altering the building or changing the use of the building and requires discussion with building consent authorities or territorial authorities on what is required to be upgraded and what the required level of safety is for altered buildings.

FENZ has reported on issues with the maintenance of fire safety systems after responding to a fire[159]. MBIE identified issues in existing boarding houses in Operation Magazine in 2023[160]. Almost all buildings inspected had at least one general fire safety systems issue, but many had multiple issues, including:

- inadequate fire and smoke separations (including fire and smoke stop doors) – this was the most common issue found
- obstructed or inadequate escape routes
- missing, misleading or illegible signs to aid egress in the case of a fire, for example exit signs
- issues with fire alarm systems, for example some detection devices were missing, provided inadequate coverage of the building, or were unmonitored or compromised in some way.

We have identified two issues with specified systems and the compliance schedules.

Issue 10-5. Accuracy of compliance schedules
Existing buildings have compliance schedules that list the fire safety systems provided in a building.
There is often a discrepancy between what was previously consented, what the compliance schedule says, and what is in the building.
These can lead to delays when altering the building or changing the use of the building and requires discussion with building consent authorities/territorial authorities on what is required to be upgraded and what the required level of safety is for existing buildings.
References to issues identified by stakeholders: STM 8

Issue 10-6. Lining materials
Existing buildings may include lining materials or products that do not comply with current fire testing requirements and whose performance may be unknown.
Because the requirements in C3.4 are quite strict, this makes it difficult to assess the performance and comply with this clause. In addition, remediation of the existing building for surface finishes is often costly.
References to issues identified by stakeholders: STM 13

[159] Refer to Appendix B.1 and historical fire events HFE 32, 33, 59, 70, and 75.
[160] Refer to Appendix B.1 and historical fire event HFE 40 – 2023 – Operation Magazine.

D.10.4 FENZ consent applications

Some applications for buildings undergoing alterations or change in use must be sent to FENZ for their review and comment. We have identified uncertainty around this requirement as an issue.

Issue 10-7. Review by FENZ
Some buildings undergoing alterations or change in use must be sent to FENZ for their review and comment. The criteria of what to send to FENZ is described in an existing Gazette Notice. This notice refers to 'minor works' not requiring to be sent to FENZ. But there is no statement of what is considered minor works for the purpose of complying with the Gazette Notice.
Similarly, it is not clear if all building consents that apply on an ANARP basis under s112 and s115 of the Building Act are meant to be sent to FENZ.
There are minor types of alteration works or minor alternative solutions which are of a low risk of non-compliance that they do not need additional attention of FENZ. FENZ review of lower risk items creates delays in the consenting process.
Clear instructions on what FENZ reviews and comments on need to be in place. The instructions should show the sort of project that need their additional time and resource.
References to issues identified by stakeholders: SRG 10