STRENGTHENING WORKSPACES: ADAPTING WELLINGTON’S EARTHQUAKE PRONE HERITAGE BUILDINGS FOR CO-WORKSPACES

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Strengthening Workspaces: Adapting Wellington’s Earthquake Prone Heritage Buildings for Co-Workspaces

By

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Fig 0.01. Aerial views of Wellington's earthquake prone and earthquake prone heritage buildings
0.1 ABSTRACT

In the late 1960s the Wellington City Council surveyed all the commercial buildings in the city and marked nearly 200 as earthquake prone. The owners were given 15 years to either strengthen or demolish their buildings. The end result was mass demolition throughout the seventies and eighties.\[1\] Prompted by the Christchurch earthquakes, once again the council has published a list of over 630 earthquake prone buildings that need to be strengthened or demolished by 2030.\[2\]

Of these earthquake prone buildings, the majority were built between 1880 and 1930, with 125 buildings appearing on the Wellington City Council Heritage Building List.\[3\] This list accounts for a significant proportion of character buildings in the city. There is a danger that the aesthetic integrity of our city will be further damaged due to the urgent need to strengthen these buildings. Many of the building owners are resistant because of the high cost. By adapting these buildings to house co-workspaces, we can gain more than just the retention of the building’s heritage. The seismic upgrade provides the opportunity for the office space to be redesigned to suit changes in the ways we work.

Through a design-based research approach this thesis proposes a framework that clarifies the process of adapting Wellington’s earthquake prone heritage buildings to accommodate co-working. This framework deals with the key concepts of program, structure and heritage. The framework is tested on one of Wellington’s earthquake prone heritage buildings, the Wellington Working Men’s Club, in order to demonstrate what can be gained from this strengthening process.

1 Reid, J., “Hometown Boomtown,” in NZ On Screen (Wellington, 1983).
3 ibid.
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ONE: INTRODUCTION
Fig 1.01. Corner of Lambton Quay and Willis Street, showing the historic King's Chambers replaced by the new State Insurance Building completed in 1984.
1.1 RESEARCH QUESTION

How can Wellington’s earthquake prone heritage buildings be adapted to suit new ways of working? This thesis explores possible adaptation processes for our current building stock and asks how the act of seismic strengthening can provide an opportunity to adapt these buildings to encourage innovative ways of working.
Fig 1.02. Corner of Hunter Street and Customhouse Quay, showing Norwich Union Building, during demolition in March 1985
1.2 METHOD

The concept of adaptive re-use is central to this design research proposition. The research begins with an investigation into current literature on adaptive re-use strategies, focusing on the four approaches discussed by Bie Plevoets and Koenraas Van Cleempoel. These strategies, (the programmatic approach and the typological approach, the technical approach and the strategic approach,) are aligned with the three key components of the research: program, structure and heritage.

The next stage of research investigates the literature on the history and future of workspace design, beginning with a history of the office. Key texts such as Nikil Saval’s *Cubed: A Secret History of the Workplace* (2014) and Francis Duffy’s *The New Office* (1997) help gain an understanding of the history of the office environment and developments in office design and future directions. Research into examples of current co-working companies, both local and international, follows. A review of these spaces as well as analysis of relevant texts such as *Planning Office Spaces : A Practical Guide for Managers and Designers* (2010) is used to understand the types of spaces required for co-working and develop a guide for the layout of these spaces.

A review and critique of current seismic strengthening methods, at a local, national and international level, is used to inform the design guide. A number of sites were selected in order to gain an understanding of the structure of a typical earthquake prone heritage building in Wellington. Drawing on the work of A. G. Cattanach, G. W. Alley and A. W. Thornton, the potential and drawbacks of typical solutions are analysed. Using a design-lead research method, initial explorations were undertaken to explore the ways in which the structure could be multifunctional.

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Fig 1.03. Corner of Manners Street and Victoria Street, showing the Britain Building demolished in 1976, replaced with McDonald's.
The heritage design considerations were developed looking at Robert, Brooker & Stone, Jäger and Cramer & Breitling’s strategies for adaptive reuse. These methods were refined in relation to the adaptation of Wellington’s earthquake prone heritage buildings to co-workspaces. The considerations were further informed by the rules and regulations set out by the Wellington City Council in its District Plan.\(^9\)

Next, a cohesive framework that clarifies the process of adapting Wellington’s earthquake prone buildings into successful co-workspaces was developed, integrating strategies dealing with program, structure and heritage as well as the important aspects of site. Wellington Working Men’s Club Building, built in 1904, an example of one of Wellington’s earthquake prone buildings with heritage significance, was chosen and adapted according to this framework. This design was critiqued in relation to how well it responds to the needs of seismic strengthening as well as the current and future office, the building’s heritage status, and how it allows for future change of use. The next step was a reflection on this framework, assessing its effectiveness against the aims and objectives of the research process. This reflection highlights how the lessons learned may be applied to other earthquake prone heritage buildings in Wellington.

The final stage of research explored the integration of workplace function and structure. This involved the development of a set of rules which outline the key considerations for such a system. The designed system must; not harm the structural performance of the structure; have sufficient strength to support itself; fit within the structural grid; and be flexible and adaptable. These rules were then followed in the development of multifunctional structural additions to the Wellington Working Men’s Club Building.

**DESIGN CONSIDERATIONS**

**ADAPTIVE REUSE APPROACHES**

- **The Programmatic Approach**
  - The Typological Approach

- **The Technical Approach**

- **The Strategic Approach**

- **THE FIFTH APPROACH**

**PROGRAM**

- Evolution of the office
  - Current office design
  - Co-working
    - We Work
    - Bond Collective
    - Biz Dojo

- Type of activity
  - Type of space required for activity

- Location of activity
  - Daylight / Artificial Light
  - Temporary / Permanent

- Aims of Program Layout
  - Connection
  - Flexibility

**STRUCTURE**

- Structural Retrofitting Approaches
  - Reason for Strengthening
  - Importance of Architecture
  - Categorization of Building Type
  - Evolution of Strengthening Methods

- Analysis
  - Review
  - Design/Consultation
    - Positioning
    - Transparency

**HERITAGE**

- Intervention
  - Conversion

- Recognize what is important about the current building
  - Scale
  - Proportion
  - Material
  - Form
  - Reason For Listing

**THE FIFTH APPROACH**

- Review Adaptation

- Opportunities

[Re] Design: Adaptation

Fig 1.04. Method diagram
APPLICATION OF FRAMEWORK
Wellington Working Men's Club
-1904-

↓

Review + Reflect

↓

DESIGN
MULTIFUNCTIONAL
STRUCTURE

Siteless Testing

Within Structure
Between Structure

Seating
Mask
Partition

↓

RULES

↓

APPLICATION OF MULTIFUNCTIONAL
STRUCTURE

Wellington Working Men's Club
-1904-

↓

Review + Reflect

↓

FINALIZE FRAMEWORK

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Fig 1.05. (Next) Map of Wellington showing locations of earthquake prone buildings, earthquake prone heritage buildings and heritage areas
1 - Post Office Square
2 - BNZ/Head Office
3 - Civic Centre
4 - St John's Church
5 - Cuba Street
6 - Wesley Church
7 - Courtenay Place

Heritage Area
Earthquake Prone Heritage
Building
Earthquake Prone Building
1.3 BACKGROUND

This plan of Wellington gives an insight into the extent of the issue of earthquake prone buildings and earthquake prone heritage buildings in the city. As shown in solid red, there are 125 earthquake prone heritage buildings that need to be strengthened or demolished by 2030.[10] This map also shows the significant number of earthquake prone heritage buildings in Te Aro, specifically in Wellington City Council’s Cuba Street Heritage Area, (heritage area number 5). These buildings in the Te Aro region have immense potential as co-working spaces. There a strong need for such spaces: current research suggests that a number of offices workers will either go freelance or spend a significant portion of their lives freelancing.[11] The recent transition of Cuba Street from a historically retail corridor to a pedestrian oriented street with a strong café culture has strengthened its identity. The central location and close proximity of creative industries, attracts such workers.

10 Wellington City Council, List of Earthquake Prone Buildings as at 06/03/2017.
11 Saval, 310.
TWO: LITERATURE REVIEW
THE PROGRAMMATIC APPROACH

Adapting a building for a new program or function

THE TYPOLOGICAL APPROACH

THE TECHNICAL APPROACH

Treats the space as a container that can be adapted for ‘functional, financial and technical ends’

THE STRATEGIC APPROACH

The strategic approach looks at the building as more than just a form to adapt, rather looks at the ‘meaning’ of the building and its life

THE FIFTH APPROACH

A new approach that combines the typological, technical, programmatic and strategic concerns, but with more sensitivity
2.1 INTRODUCTION

This research aims to develop a framework that aids in the adaptation of historic buildings to co-workspaces. An investigation into the current adaptive reuse strategies aligns them with the three key concepts of program, structure and heritage. Each of these concepts is researched in order to gain a clear understanding and inform the formulation of design considerations. Each of these concepts are vital when dealing with adapting Wellington’s earthquake prone heritage buildings to co-workspace.

2.2 ADAPTIVE REUSE

The practice of “adaptive re-use” is a very old one, but it is only recently being discussed in academic writing. In “Adaptive Reuse as an Emerging discipline: an Historic Survey” Bie Plevoets and Koenraas van Cleempoel review the emergence of adaptive reuse from the historic debate of restoration versus conservation. The restoration movement, founded in the nineteenth century by French architect Emmanuel Viollet-le-Duc involved “adding completely ‘new parts’ to the building, albeit in the style of the original.” Conservation grew out of a criticism of this kind of restoration. The English Art Historian John Ruskin believed restoration was “a destruction accompanied with false description of the thing destroyed.” He believed that a building “should be allowed to exist on its own terms and display its own history. It should be conserved.” [12]

As a result of the destructiveness of the two world wars, heritage became about more than just medieval and antique buildings. The debate became Conservation and Restoration vs Modern Architecture. In the 1960s and ‘70s architects such as Carlo Scarpa, Raphaël Moneo and Sverre Fhen began working with historic buildings as their specialty, and the gap between architecture and conservation narrowed.

In their attempts to define adaptive reuse Plevoets and Van Cleempoel summarised four approaches to adaptive re-use: the programmatic approach,
the typological approach, the technical approach and the strategic approach, before suggesting a possible fifth contemporary approach. The programmatic approach involves selecting a specific function or program as a starting point and then adapting the host building to accommodate it. The typological approach is based upon pioneering researcher Sherban Cantacuzino’s book “New Uses for Old Buildings,” in which he looked at buildings with various functions and how these buildings could be adapted for new functions. The technical approach treats the space as a container that can be adapted for “functional, financial and technical ends.” This approach focuses on practical aspects of space including fire resistance, thermal performance, acoustic properties, prevention of damp, condensation and timber decay. The technical approach pays no attention to the genius loci or prevailing character or atmosphere of a place. The strategic approach looks at the building as more than just a form to adapt, rather it looks at the ‘meaning’ of the building and its life. This idea was first presented by Raldolfo Machado in Architecture as Palimpsest where he looked to overlay a formal intervention with the existing form.

In the process of remodelling, the past takes on a greater significance because it, itself, is the material to be altered and reshaped. The past provides the already-written, the market "canvas" on which each successive remodelling will find its own place. Thus, the past becomes a "package of sense", of built-up meaning to be accepted (maintained), transformed, or suppressed (refused).

Since this initial writing, this poetic understanding of adaptive reuse has been covered by theorists such as Philippe Robert, Graeme Brooker and Sally Stone, Frank Peter Jäger and Johannes Cramer and Stefan Breitling all whom use a classification of strategies that acknowledge a more affective aspect of adaptation.

The new fifth approach combines all of the concerns of the four methods of typological, technical, programmatic and strategic but with more sensitivity. When adapting Wellington’s earthquake prone heritage buildings to co-workspaces, aspects of all four of these approaches will come into play. The

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13 Plevoets, B. & Cleempoel, K.
approach will combine all of the necessary aspects of these current approaches such as a change in use, the functional aspects of a structural upgrade, the sympathetic nature of dealing with a historically listed building, understanding the importance of the buildings character and finally looking at the building as a series of ever changing layers in a poetic sense. Throughout the rest of this chapter each of the major research components – program, structure and heritage - will be explored in relation to adaptive reuse.

2.2.1 LAYERS

What happens to buildings after they are built, when the users take over and re-shape the building to suit their own needs? How Buildings Learn by Stewart Brand is all about designing and creating buildings that work over time. Part of this is designing in a way that allows buildings to evolve as the occupants themselves change. As Brand says, “an adaptive building has to allow slippage between the differently placed systems of site, structure, skin, services, space plan and stuff.”[15] Otherwise the slow, more permanent systems block the flow of the quick ones with their constant change. The buildings that survive are the ones which are flexible enough to adapt to the changing needs and tastes of successive generations.

Brand’s ideas are especially useful when looking at the adaptation of Wellington’s earthquake prone buildings in relation to the rapid evolution of office design. Using Brand’s ideas about the layers in a building is helpful to the process of adaptation. Brand says “The lethargic slow parts are in charge, not the dazzling rapid ones. Site dominates the Structure, which dominates the Skin, which dominates the Services, which dominates the Space plan, which dominates the Stuff.”[16] Brand’s theory is used to guide the investigation into what layers need to be altered or added to allow for a long building life, with easy future adaptation. In relation to this thesis proposition, an interesting investigation occurs when looking at the effect of updating a building’s structure, a layer which Brand defines as “the foundation and load-bearing elements… These are the building.”[17]

Robert Campbell talks about the idea of recycling buildings; “The best buildings are not those that are cut, like a tailored suit, to fit only one set of functions, but rather those that are strong enough to retain their character as they accommodate different functions over time.”[18] He highlights the importance of this slight misfit between old and new which gives such places their special edge and drama. Brand shares the same opinion, “the building became more interesting when it left its original function behind. The continuing changes in function turn into a colourful story which becomes valued in its own right. The building succeeds by seeming to fail.”[19]

It is when buildings adapt for a change in function, and new layers are added to accommodate these changes, that the character of a building is developed. The addition of a new layer of structure in the process of adapting one of Wellington’s earthquake prone heritage buildings is a chance for these buildings to evolve and develop.

16 Brand, S., 17.
17 Brand, S., 13.
    Cited in Brand, 104.
19 Brand, 20.
Fig 2.04. Taylorism c. 1910, Taylor's values of order, hierarchy, supervision and depersonalization, became an integral part of the architecture of pioneering office design
2.3 PROGRAM

The typological approach and the programmatic approach are both adaptive reuse strategies that look to adapt a building for a new program or function. In order to develop a cohesive framework for the adaptation of Wellington’s earthquake prone heritage buildings for co-workspaces the program has to be understood and clearly defined. A review of key texts by Francis Duffy, Carol Willis, Nikil Saval, Jeremy Myerson and Philip Ross helps clarify how the design of the office has evolved over time, looking at its evolution from the nineteenth century to today. This analysis will inform speculation about what an office might be in the future.

THE HISTORY OF THE OFFICE

The office developed from the countinghouses found in the middle of the nineteenth century. Nikil Saval describes such spaces as, “a sort of tank, where men entered in the prime of health and exited shrunken and phthisic; where so much activity took place, but only paper seemed to be produced.” [20] These early offices were small, intimate and informal spaces with clerks and partners sitting near each other. Everyone dealt with everything. As Myerson and Ross note, developments in the twentieth century came about following a path of modernization and technical advance. The beginning of a “new century acted as a catalyst for a cluster of new inventions – among them the light bulb, elevator, telephone and typewriter – that revolutionised the world within dedicated office buildings.” [21]

The modern office building appeared in the late nineteenth century. In Form Follows Finance, Carol Willis looks at the economic and programmatic formulas for quality office space and the buildings that housed these offices, namely, skyscrapers developed in the United States in the 1880s. Willis describes two periods of skyscraper design, the first, beginning in the last quarter of the nineteenth century (described as vernacular) and the second, beginning after a long hiatus following the great depression and World War II

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20 Saval, N., 4.
Fig 2.05. 1960 Burolandschaft (office landscape)
(described as international). The vernacular skyscraper is characterised by forms that were very connected to the environment: light and site were fundamental to the design. Before the 1940s, the interior of offices were dependent on natural lighting for illumination: this resulted in offices that had a very strong relationship to the boundaries of the building. International style skyscrapers were a result of many developments in technology and material. The style of such buildings was in keeping with the international style aesthetics, using materials such as steel, and glass, and emphasizing spatial volumes and structural expression. The main characteristics of international skyscrapers is the lack of relationship between the building, its site and its surroundings. Due to advancements in technology such as fluorescent lighting and air-conditioning, these skyscrapers were independent of their site and could be located in any city and climate.\[22\]

While it is important to consider the exterior of the office buildings, the development of the office interior is also important. American engineer Frederick Taylor is credited as the inspiration behind the principle of efficiency dictating the design of first factories, and then modern office spaces. Taylor addressed problems around incentives and efficiency of the manufacturing process: his ideas became known as ‘Taylorism’\[23\]. He treated people as if they were units of production creating efficiency but also resulting in the dehumanization of work. Central to his theory was hierarchy: everyone had their place. Taylorism was the dominant management philosophy at the time when the office building typology was created. Taylor’s values of order, hierarchy, supervision and depersonalization, became an integral part of the architecture of pioneering office design (Fig 2.04). Beginning in the early twenty-first century, similar to the factory, workers were crowded together in a completely open space, where bosses looked on from private offices. These early offices accommodated not just the management philosophy of the time but also the most up to date construction methods, building services and real estate practices. These innovations were so successful that, once established the patterns of office building immediately crystallised. Consequently the design of the office has been resistant to change since the mid-twentieth century.\[24\]

\[22\] Willis, C., Form Follows Finance: Skyscrapers and Skylines in New York and Chicago. 1st ed. (New York: Princeton Architectural Press, 1995).
\[23\] Saval, N., 45.
\[24\] Duffy, F., 17.
Fig 2.06. 1968 Robert Propst’s Action Office II
Despite the popularity of this model during the second half of the twentieth century, there were some new developments within the world of the office. The first was the idea of the Burolandschaft (office landscape) in the 1960s (Fig 2.05). This was a reaction to the uniformity of previous office designs. This type of office design had no internal doors or partitions, and had organic groupings of desks designed to encourage conversations and create a happier workforce. Businesses began to flatten hierarchies and move towards more socially democratic layouts, encouraging communication and collaboration. This breakdown in the traditional office structure was the beginning of change.\(^{[25]}\)

Throughout the twentieth century designers attempted to make the office more efficient and better adapted to the way people work. Time and time again the best intentions lead to disaster and the office of the future became more of the same. This is apparent in the designs of Robert Propst. The original design in 1964 by Propst for the “Action Office,” was the world’s first open plan office system made up of reconfigurable components including shiftable, modular walls set out at 120 degree angles (Fig 2.06). Propst imagined a system that could be changed at a moment’s notice, a design that was forgiving and flexible. It was a furniture system based on human movement and consisted of moveable partition walls, a desk, shelves at varied heights and pin boards.\(^{[26]}\) When reflecting on the Action office, Francis Duffy said, "someone figured out that you didn’t need the 120-degree [angle], and it went click. That was a bad day. It took only five seconds for Action Office to turn into a box" (Fig 2.07).\(^{[27]}\) As Propst’s Action Office got replicated again and again, his visionary design became standardised and less user friendly.

By the late twentieth century the office had developed from the early days of clerks and partners working side by side, to the infamous cubical office. More recently, we have seen the rise and fall of the virtual offices and “hoteling”, where individual workspaces are booked by on an as-needed basis. Now, we are at a time of campus offices – low-rise office buildings, reminiscent of university campuses, seen as a way to encourage collaborative working and social interaction, the design of these buildings reflects the changing attitudes towards the way we work and hot-desking – location independent.

\(^{25}\) Duffy, F., 17.  
\(^{26}\) Saval, N., 207.  
\(^{27}\) Saval, N., 220.
Fig 2.07. Action Office as cubicles
working where instead of being assigned a single desk, multiple workers share a workstation during different hours, best suited to businesses that do not require all staff to be at the office at once. Another cluster of inventions – the internet, email and the cell phone – have had a catalytic effect on offices in the twenty-first century. These inventions along with new management ideas have helped to enforce further changes. The twenty-first century office ideals are a direct reaction to the ideas of the twentieth century. Not all workplaces have kept up with these changes. “We’ve all been taught that the corner office is a badge of success. It’s difficult to change that.” The way that we work and the structure of the office has changed and the workplace needs to reflect this.

THE FUTURE OF THE OFFICE

Looking at this history it is clear that offices are always evolving: this means the design must be flexible, and the structural upgrade and adaptation must reflect this. It is important that any adaptation looks at what is current and what is new in terms of office design, such as co-working and activity based working, where a range of different spaces are available encouraging people to locate themselves in the most appropriate location to undertake a specific task. As well as looking at a type of office design that is appropriate for the context. It is important that the design aims to be flexible, and provide a space for people to work productively while allowing collaboration between users.

Co-working provides the ultimate flexibility for workers and employers. Employers don’t need to pay for expensive office infrastructure, and employees can have a much more flexible work environment. The introduction of more co-workspaces in the city would allow for a change in the current expected work environment. The city will be able to accommodate work in a different way, providing flexible dynamic locations for workers from all sorts of industries and professions. The adaptation of a series of buildings along Cuba Street creates the opportunity for a Cuba Street co-working corridor.
2.4 **CASE STUDIES**

Two particular office designs provide precedents for contemporary office design, focusing on flexible working spaces and the potential of structure to be multifunctional, these are TBWA/Chiat/Day and Superdesk.

Fig 2.08. TBWA/Chiat/Day office interior by Clive Wilkinson Architects
TBWA/CHIAT/DAY
Clive Wilkinson Architects, Los Angeles, 1997

TBWA/Chiat/Day is an advertising agency whose offices have evolved dramatically over time. Jay Chiat, the man behind the changes, was a leader in office evolution and was not afraid of a few failed attempts. Chiat was unhappy with the redesign of his Venice, California, office in 1991 by Frank Gehry, so in November 1993, Chiat announced his plan. The walls, desks and cubicles were going. So were the desktop computers and the phones. Anything that a person could call ‘theirs’ was gone. Chiat called it “team workroom,” everyone else called it a “virtual office.” The office failed. The politics within the office were strengthened. People arrived and had no idea where to go, so they left. In 1998, the experiment was declared over – a more traditional, or at least less chaotic, design was commissioned.

Architect Clive Wilson was hired to redesign TBWA/Chiat/Day offices in 1997. The scheme set out to create an urban neighbourhood based on Greenwich Village – an advertising city. Everyone would have their own personal place to work as well as access to shared ‘public’ amenities such as a formal and informal meeting rooms, a park, a basketball court and a café. Architect Clive Wilkinson spent a lot of time getting to understand the company, the culture and the way the work was done. This resulted in an office design that is still a successful work environment 20 years after its design.

TWBA/Chiat/Day is a clear example of office development. Jay Chiat was aware that with the evolution of technology the way people work had to change. He was not afraid of pushing the boundaries, even if his employees were. The evolution of TWBA/Chiat/Day’s offices highlights the importance of understanding the way we work. The “team workroom,” or “virtual office” experiment shows the effect of too much flexibility. It is important that even in a contemporary workspace, there is a sense of organisation and a clear balance between fully enclosed offices and completely open space.

Myerson, J. & Ross, P. 92.
Clive Wilkinson, the same architect who revolutionized Chiat Day, once again challenged the traditional office setup. The Barbarian Group, a digital advertising agency required a workspace that would foster collaboration and transparency in their growing company while challenging their creativity. The Barbarian group wanted everyone to sit at one desk, and have spaces where people could escape. Clive Wilkinson Architects design made that happen essentially with one large table going through a room.

Starting with an existing office building, the first step was removing all the offices and rooms down the centre of the spine to create a large open space. All of the outside rooms were repurposed for the meeting rooms and editing suites. A curved table was then added in the centre of the room, each curve and arch deliberately designed in direct relation to the lines of circulation through the space.\[30\]

This project is a great example of a workplace pushing the boundaries of traditional office design. The single workspace allows all of the 170 employees to work together on a single surface, while the undulating nature of the surface allows for the office to be subtly divided. The Superdesk structure is also an interesting example of a multifunctional structure. The interlocking plywood and MDF structure not only supports the unbroken white resin surface but also acts as seating and shelving throughout its waves. “We think that it is actually a very sensible reaction to a new set of circumstances and we seriously believe that in the year 2030 this sort of thing is going to be really normal.”\[31\]

The main critique of Superdesk is the separation of the surface and the buildings structure, although Superdesk is a somewhat permanent office system, it does not integrate with the structure of the building. This research looks at the need for an adaptable system that integrates with the structure, thinking about the permanent nature of structure and the necessity of flexibility of workplace additions.

31 ibid.
2.5 STRUCTURE

Key to adaptive re-use is the re-use of historical structures, making them suitable for new functions. In Wellington, the central issue with re-use is to ensure buildings meet contemporary seismic regulations.

The technical approach is an adaptive re-use strategy that looks to adapt or upgrade a building to meet new requirements such as a change in fire code regulations, thermal requirements, or other building code requirements. In the case of this research, the technical approach focuses on the structural upgrade of a building to meet new seismic requirements. An analysis of Andrew Charleston’s *Seismic Design for Architects: Outwitting the Quake* clarifies why it is important to strengthen buildings in seismic zones and why it is important for architects to get involved in this process. A review of Adam Thornton’s *Twenty-five years of Strengthening Wellington* helps to categorize the type of buildings covered in this framework and explore the type of structure typically used as well as the various methods of strengthening that have been employed over time. Together this literature supports research seeking to adapt Wellington’s historic buildings for new ways of working.
Currently there are over 630 earthquake prone buildings in Wellington that need to be strengthened or demolished by 2030. Of these earthquake prone buildings, the majority were built between 1880 and 1930, with 125 buildings appearing on the Wellington City Council Heritage Building List. In Seismic Design for Architects: Outwitting the Quake, structural engineer Andrew Charleson outlines the purpose and process of retrofitting: “The purpose of retrofitting is to reduce the vulnerability of a building’s inhabitants and the building itself – its structure, non-structural elements and possibly its contents to earthquake damage.” The most common reason for a retrofit is new regulations imposed by the central or local government. In Wellington, just like many regions in New Zealand, the rules require a building to be at least 34 per cent of New Building Standard (NBS). However it is recommended that a retrofit should bring the building to ‘as near as is reasonably practicable’ to the standards pertaining to a new building. There are many reasons to upgrade a building’s structure to a higher percentage. Charleson recommends that any building should be strengthened to at least 67 per cent of current code: “the effect of bringing a building from 33 to 67 per cent of current code is to reduce its risk of severe damage from 25 times to 5 times that of a new building.” The need for this significant amount of upgrading applies to a significant proportion of character buildings in the city. There is a danger that the aesthetic integrity of our city will be damaged due to the urgent need to strengthen these buildings. Many of the building owners are resistant because of the high cost, however it is important that a solution for strengthening is put in place, for the sake of safety, and also so that the city does not lose its historical character.

32 Wellington City Council, List of Earthquake Prone Buildings as at 06/03/2017.
35 Charleson, A., 187.
STRUCTURAL RETROFITTING APPROACHES

Retrofit strengthening approaches should aim to be as minimally invasive as possible. A building’s structure can be improved in one of three ways. Following an engineer’s evaluation of the current structure the most appropriate methods will be chosen. Option one is an upgrade of individual parts of the current structure. Option two is to change the current structure from one type to another. Option three - the most invasive method – involves the insertion of an entirely new structural system. New systems such as shear walls, braced frames and moment frames are essentially the same systems that would be used in new buildings, however they need to be structurally connected to the existing construction and often require new foundations to prevent overturning. All upgraded and new systems must be configured in plan not only to resist seismic forces in two orthogonal directions, they must also be positioned to resist torsion.[36]

36 Charleson, 195

ONE
An upgrade of individual parts of the current structure

Fig 2.10. (Above and Opposite) Structural retrofitting diagrams
TWO
Change the current structure from one type to another

Moment frame to braced frame
Braced frame to shear wall

THREE
The insertion of a new structural system

Braced frame to shear wall
Braced frame to moment frame
Moment frame to braced frame
ARCHITECTURAL INPUT

A key issue in the seismic strengthening process is the frequent lack of architectural input. Engineers are often the leading professionals in structural upgrades, so often architectural considerations become secondary.\(^{37}\) Because there are no laws about the architectural implications of the various retrofit alternatives, there needs to be a greater understanding from both engineers and architects about disciplinary specific issues. Considerations such as: how do the retrofit alternatives impact of the façade of the building? How does the structural upgrade effect the spatial layout of the building? Should the new structure be expressed? And what should this detailing look like? All these questions need to be asked and understood by the architect, engineer and building owner. This is why it is important that the design considerations are integrated into a framework so they can inform each other and are not viewed in isolation.

TWENTY-FIVE YEARS OF STRENGTHENING WELLINGTON

In order to gain an understanding into the structures used in Wellington’s earthquake prone buildings, and to check if there is a consistent approach throughout the buildings, four of Wellington’s earthquake prone heritage buildings were chosen and analysed. These buildings are Stewart Dawson’s Corner, constructed in 1900, located on the corner of Willis Street and Lambton Quay; Toomath’s Building, also constructed in 1900, located on Ghuznee Street; Wellington Working Men’s Club, constructed in 1904, located on Cuba Street and Maguire’s Building, constructed in 1900, also on Cuba Street. An analysis of these buildings showed that their structure was load-bearing brick masonry with concrete foundations. The building type can be categorized as medium rise unreinforced masonry. In *Twenty-five years of Strengthening Wellington*, structural engineer Adam Thornton describes such buildings as up to six stories high, commonly constructed with unreinforced brick side walls, timber floors and open retail fronts. These buildings usually have very little transverse strength or stiffness. They often lack floor-to-wall ties.\(^ {38}\)

\(^{37}\) Charleson, A.


Fig 2.11. (*Left*) Map of Wellington showing the location of selected buildings and collages of selected buildings
DEVELOPMENT OF STRENGTHENING TECHNIQUES

The majority of Wellington’s unreinforced masonry buildings date from the period 1900-1930. The 8.2 earthquake on Jan 23rd 1855, centred on the Wairarapa Fault, resulted in a shift in construction methods from brick to timber. It was not until the early 1900s, following a number of large fires, that brick was brought back into common use. The 1929 Murchison and 1931 Napier earthquakes, as well as the introduction of a seismic design legislation in 1935 and the emerging technologies of structural steel and reinforced concrete saw the demise of brick as a structural material again in the mid twentieth century.

Strengthening techniques have developed since the first push for seismic strengthening in the 1970s. This was brought about by central and local government’s first assessment of older, understrength buildings and the risk these buildings posed to their inhabitants and to the commercial viability of the city. Since this time, “through experience and innovation, the structural-effectiveness, appropriateness and cost-effectiveness of the solutions have improved significantly.”[39] Today the techniques for strengthening these unreinforced masonry buildings include (Fig 2.12):

- The insertion of primary transverse frames such as:
  - Eccentric chevron bracing (K-Frames)
  - Reinforced concrete moment resisting frames (MRFs)
  - Steel, rectangular portal frames.

- Fixing floor and roof diaphragms (and new transverse frames) through the use of low capacity fixings between a perimeter member and both the brickwork and timber joists.

- Providing out of plane strengthening to brick walls through the insertion of steel mullions, predominantly for upper-story walls carrying small gravity loads.

39 Thornton, A.
- Strengthening walls when they have insufficient in plane strength
  - With sprayed concrete
  - Additional walls
  - Stiff frames

- Improving diaphragm strength or increasingly large floor plates
  - Steel flat bracing
  - Sheet bracing above or below the floor
  - Reducing diaphragm spans by adding more frames.

Recent developments in strengthening techniques for unreinforced masonry buildings include.
  - Vertical post-tensioning for the improvement of both in-plane and out-of-plane performance
  - Fibre Reinforced Polymer
  - The use of controlled-deflection yielding devices.

With the development of these structural techniques there have also been increases in the standard of strengthening required for buildings in Wellington. This is another reason why when strengthening a building, it is important to aim for more than the minimum standard required, currently 34% NBS. As a result of the changing requirements and evolution of strengthening techniques there are many buildings that have a variety of strengthening systems within a single building. Often these systems are not efficiently working together. This is one aspect that will be addressed in the framework development.
THE INSERTION OF PRIMARY TRANSVERSE FRAMES

- Eccentric chevron bracing (K-Frames)
- Reinforced concrete moment resisting frames (MRFs)
- Steel, rectangular portal frames.

FIXING FLOOR AND ROOF DIAPHRAGMS

Fixing floor and roof diaphragms (and new transverse frames) through the use of low capacity fixings between a perimeter member and both the brickwork and timber joists.

OUT OF PLANE STRENGTHENING

Providing out of plane strengthening to brick walls through the insertion of steel mullions, predominantly for upper-story walls carrying small gravity loads.

Fig 2.12. (Above and Opposite) Diagrams methods of strengthening
INSUFFICIENT IN PLANE STRENGTH

Sprayed concrete
Additional walls
Stiff Frames

DIAPHRAGM STRENGTH

Steel flat bracing
Sheet bracing above or below the floor
Reducing diaphragm spans by adding more frames
Robert, 1989
*Adaptations, new uses for old buildings*

Brooker & Stone, 2004
*Rereadings: interior architecture and the design principles of remodelling existing buildings*

Jäger, 2010
*Old & new: design manual for revitalizing existing buildings*

Cramer & Breitling, 2007
*Architecture in existing fabric*

**Fig 2.13. Diagram of adaptive reuse strategies**
2.6 HERITAGE

Part of the value of adaptive re-use is the preservation of the historical character and meaning of the city, through the preservation of historic buildings. The strategic approach encompasses adaptive reuse strategies that look at buildings as more than just forms to be adapted; these strategies look at the ‘meaning’ of the building and its relationship to the life of the city. In order to develop a cohesive framework for the adaptation of Wellington's earthquake prone heritage buildings for co-workspaces, the process of adaptation has to be understood and clear methods of dealing with heritage buildings need to be defined. A review of key texts by Philippe Robert, Graeme Booker and Sally Stone, Frank Peter Jäger and Johannes Cramer and Stefan Breitling reveal the various approaches there are to adapting buildings. These are then analysed in relation to their relevance to the adaptation of Wellington's earthquake prone heritage buildings to co-workspaces.

Philippe Robert analyses the attitudes towards re-using existing buildings including historic preservation, re-interpretation and the affirmation of contrast. He creates an inventory of approaches that include, building within, building over, building around, building alongside, recycling materials of vestiges, adapting to a new function and building in the style of. Robert's inventory highlights the importance of the memory of place and the future use in the conversion process, with reference to Raldolfo Machado's idea of architecture as palimpsest.\textsuperscript{40} Brooker and Stone have developed three categories for building reuse based upon the extent of the integration between the host building and the new elements. The approaches - insertion, intervention and installation – start from the physical intervention but focus on the affective aspects, relating to feelings and emotions, of each adaptation. For Brooker and Stone the most meaningful factor in adaptive reuse is the original building.\textsuperscript{41} Jäger categorises case studies according to the applied strategy towards the existing fabric. The three categories are transformation, addition, and conversion.\textsuperscript{42} Cramer and Breitling make a distinction between ‘design strategies’ and ‘architectonic expressions’ whereby they describe design strategies as physical interventions and alterations to the building and architectonic expressions as the aesthetic qualities of the intervention. These

interventions are corrective maintenance, modernisation, adaptation and replacement.\footnote{Cramer, J. & Breitling, S., \textit{Architecture in Existing Fabric}. (Berlin: Birkhauser, 2007).}

This table, (Fig 2.13), adapted from “Adaptive Reuse as a Strategy Towards Conservation of Cultural Heritage”\footnote{Plevoets, B. & Cleempoel, K., 155-163.} attempts to relate each author’s strategy towards adaptation and begins to highlight the relevant approaches when considering the adaptation of Wellington’s earthquake prone heritage buildings. It shows that the most appropriate strategies are intervention and conversion.

Brooker and Stone talk about intervention as the process of designing when the most important design influence is the relationship between old and new: “The existing building is so transformed that it can no longer viably exist independently and the nature of the remodelling is such that the old and new are completely intertwined.”\footnote{Brooker, G. & Stone, S. 14.} This is aligned with the concept of conversion, which is described by both Jäger and Cramer and Breitlink. Jäger describes conversion as the process of converting a building for a new use, this conversion is often the reason or saviour of the old building, whose current use has become obsolete. Conversion is referenced by Cramer and Breitling within their category of adaptation. It involves making sometimes significant changes to the building substance but respecting its overall volume. Analysing these strategies in terms of adapting Wellington’s earthquake prone heritage buildings shows the importance of looking into the heritage of the building.

The concepts of conversion and intervention both highlight the necessity of using the original buildings past as a driver for design. Due to the structural weakness of the current buildings, the insertion of new structure is in many cases inevitable. It is the treatment of the intersection of old and new that must be clearly clarified in the heritage design considerations. These strategies of integration and conversion clarify the importance of the intersection of old and new and the respect that needs to be paid to the building’s character. For the old building to be respected, it has to be critically analysed in order to understand what aspects of the building are having a positive influence on its character. This is also developed in the heritage design considerations.
THREE: DESIGN CONSIDERATION DEVELOPMENT
3.1 PROGRAM

CO-WORKING

This research study proposes co-working as an appropriate function for many of Wellington's earthquake prone buildings in the Te Aro district. This program was chosen as a contemporary way of re-figuring work; and because it is appropriate in the context of this area's creative industries.

Through the analysis of three co-working companies - We Work, Bond Collective and Biz Dojo - and a review of Planning Office Spaces: A Practical Guide for Managers and Designers the type of activities required for co-working were defined and analysed as are the spaces where these activities occur. This analysis looks specifically at the length of time spent in each space, the area per person required for each activity, the number of people in each space and the degree of enclosure. The types of meeting rooms and meeting spaces, as well as the support spaces required for co-working are also defined and analysed.

The programmatic design considerations are developed by looking at what co-working is, the activities required, the type of space required for these activities and their location. An initial guideline is developed that focuses on the arrangement of spaces in relation to daylight. This is then tested on a simplified form representative of a typical earthquake prone heritage building in Wellington. Finally a developed program consideration is presented in the form of a scatter plot which helps to direct the layout of activities within a building, separating activities both horizontally and vertically in space.
co-working

NOUN

[Mass noun]

The use of an office or other working environment by people who are self-employed or working for different employers, typically so as to share equipment, ideas, and knowledge.

“The whole idea of co-working is to bring bright, creative people together and let the ideas collide.”[46]
3.1.1 CO-WORKING CASE STUDIES

WE WORK
Worldwide

We work is a co-working company with workspaces all over the world. Each workspace has been designed with teams in mind, their spaces are as dynamic as their tenants. The facilities range from standard things including WIFI and printing to amenities such as an app for all members to book meeting rooms and private spaces.

Fig 3.01. We Work interior
Bond Collective is a New York co-workspace company that offers similar services to We Work as well as specialist equipment such as music and TV recording studios. Their workspaces focus on collaboration and community with special focus on creativity and innovation.
Biz Dojo is a local example of a co-workspace, with offices in Wellington, Auckland and Christchurch. They have a focus on supporting start up businesses offering a space to bring people together to collaborate, encourage and learn from one another.

Fig 3.03. Biz Dojo interior
This analysis of the amenities available at each co-workspace begins to suggest the types of facilities that are standard such as WIFI, printing and events, as well as introduce specialist amenities that are unique to each company that may be useful additions in a future co-workspace in Wellington. These include features such as music and video recording studios, specialist apps for members that allow meeting spaces and private rooms to be booked at the touch of a button, and on site bike parking.
We Work

Bond Collective

Biz Dojo

MEMBERSHIP

Each co-workspace company has a range of membership options including: casual/flexi passes, for part time or one off users - these memberships allow access to hot-desking areas and the use of meeting rooms - dedicated desks, hot desk, group memberships and private office memberships. The most important aspect is the interaction of each of these members, with each other and the public. Co-workspaces provide the opportunity for flexible working while fostering collaboration.

3.1.2 ANALYSIS OF ACTIVITIES

The following pages contain a spatial analysis of the space required for the activities found to be typical in a co-workspace. This analysis looks specifically at the length of time spent in each space, the area required per person, the number of people in each space and the degree of enclosure. The spaces have been split into three categories: workspaces (Fig 3.06), meeting rooms (Fig 3.07) and support spaces (Fig 3.08).

Fig 3.05. Co-working membership icons
WORKSPACES

HOT DESK
An open workspace for 10 or more people, best suited for routine activities requiring low concentration or activities which demand frequent communication.

DEDICATED DESK
A designated desk in an open working environment, best suited for routine work.

TEAM SPACE
A semi-enclosed work space for 2 - 8 people, useful for collaborative work with high levels of internal communication and medium concentration levels.

PRIVATE OFFICE
An enclosed workspace for one person, used for activities that require a high level of concentration or that have a high level of confidentiality.

Fig 3.06. (Above and Opposite) Types of workspaces
SHARED OFFICE
An enclosed workspace for 2 or 3 people, used for collaborative work in small groups.

TEAM ROOM
An enclosed workspace for 4 to 10 people, used for teamwork which may be confidential and demand frequent internal communication.

STUDY BOOTH
An enclosed workspace for one person, used for short term activities that require a high level of concentration or confidentiality.

WORK LOUNGE
A lounge-like workspace for 2 to 6 people suitable for short term activities which demand collaboration and impromptu interaction.
MEETING SPACES

SMALL MEETING ROOM
An enclosed meeting space suitable for 2-4 people, for both formal and informal interactions.

LARGE MEETING ROOM
An enclosed meeting room for 5-12 people, for formal interactions.

SMALL MEETING SPACE
An open or semi-open meeting space for 2-4 people, for short informal interaction.

Fig 3.07. (Above and Opposite) Types of meeting spaces
BRAINSTORM ROOM
An enclosed meeting space for 5-12 people, for brainstorming sessions and workshops.

MEETING POINT
An open meeting point for impromptu informal meetings.

LARGE MEETING SPACE
An open or semi-open meeting space for 5-12 people, for short informal interaction.
SUPPORT SPACES

FILING/STORAGE AREA
An open or enclosed support space for the storage of frequently used files and documents.

EVENT SPACE
A large flexible area for lectures, large gatherings and events.

PRINT AND COPY AREA
An open or enclosed support space with facilities for printing, copying and scanning.

MAIL AREA
An open or semi-open support space where employees can pick up or deliver their personal mail.

Fig 3.08. (Above and Opposite) Types of support spaces
KITCHEN AREA
An open or enclosed support area where people can make hot drinks, store and heat food.

BREAK AREA
A semi-open or enclosed support space where employees can take a break from their work.

LOCKER AREA
An open or semi-open support space where employees can store their personal belongings.

GAMES
An open or semi-open support space where employees can relax.
Flexible Workspaces

Permanent Workspaces

Fig 3.09. Initial guideline

DAYLIGHT
3.1.3 LOCATION OF ACTIVITY

*Initial Guideline*

This analysis was used to test possible spatial configurations to inform the preliminary design. It looks at the possible layout of each space in terms of their location to either daylight or artificial light - this is because most of Wellington’s earthquake prone heritage buildings have a single line of windows along the street façade and three solid walls. This test also classifies the spaces in terms of permanent and flexible workers. Permanent workers are those that use the offices on a mid to long term basis, often having a reserved desk with their team or by themselves. Temporary workers are those that use the office for a short term or sporadic nature. They are more likely to have a hot desking arrangement, when they do not have a dedicated desk, instead use a different desk each time they enter the office.
Fig 3.10. Vertical distribution of activities
Before applying this initial layout to a generic building it was found that there was no way of dealing with the vertical levels of a building. This diagram explores possible strategies to deal with separating activities across multiple floors. The most logical approaches were a transition from public to private as well as temporary to permanent workers.
LEVEL TWO
Meeting Rooms
Team Rooms
Shared Office
Study Booths
Dedicated Desks
Storage/Mail/Printing

LEVEL ONE
Hot Desks
Team Space
Work Lounge/Break Area
Meeting Room
Meeting Area
Storage/Printing
Lockers
Games
Kitchen

GROUND
Cafe
Hot desking
Reception
Team Space
Work Lounge/Break Area
Event Space
Storage
Lockers
Printing

Fig 3.11. Initial design and program layout
INITIAL SPATIAL LAYOUT

The test was used to inform the layout within a generic building. The chosen building is three levels, with three enclosed walls and a single semi-glazed façade along the street edge. This exemplar building is used to represent one of Wellington’s earthquake prone heritage buildings.

This initial design had a more public ground floor with a café and event space. Level one was designed for temporary workers and included hot desks, meeting spaces, areas to relax and private study booths. Level two was for more permanent teams and individuals and was made up of meeting rooms, dedicated desks, team zones and private offices.

Fig 3.12. Initial design plans
VERTICAL CIRCULATION

ELEVATOR

FEATURE STAIR

TIGHT STAIR

VOID+STAIR

Fig 3.13. Diagrams exploring vertical circulation options.
REVIEW OF PRELIMINARY SPATIAL LAYOUT

Looking more in depth into the separation of space across floors, the preliminary spatial layout confirmed that regardless of the strategy used for the separation of space across the levels, there were going to be issues to overcome. The most crucial being the lack of connection between the floors, causing a lack of interaction between the workers. Future designs will explore possible solutions such as creating a void through the building or moving the circulation to the centre of the building to increase the connection between the floors.

The initial test only addressed the programmatic issues of site. However the structure and heritage are important considerations to be further developed. The position of structure is already indirectly having an influence over the position of the layout, but future analysis looks at how this integration can be a positive opportunity. Possibilities include the option for the integration of acoustic and/or visual privacy introduced with the structure.

Further design iterations test the alternative distribution of spaces throughout each floor as well as looking into methods of creating a connection throughout the building. They provide guidance for creating a connection between the temporary workers, the permanent workers and the public. The next design tests also begin to explore what aspects of the building will need to be adapted to suit the new use as a co-workspace, helping to inform the final integrated framework.
Individual Workspaces

Permanent Individual and Team Workspaces

Private Offices

Study Booths

Meeting Rooms

Meeting Spaces
3.1.4 PROGRAM DESIGN CONSIDERATIONS

This scatter plot shows the array of design considerations, looking specifically at the arrangement of activities throughout space. The diagram acts as a generic guide to aid the layout of activities. It can be applied to various sized buildings with any number of levels.
3.2 STRUCTURE

Seismic strengthening is an evolving discipline: engineering has moved on from interim securing and strengthening of the perceived weakness. Today engineers carry out a performance based appraisal of the building as a whole. The practice of seismic strengthening has grown significantly since the 1960s. Methods such as generally securing/demolishing parapets, tying walls to floors, and inserting primary frames where there was little or negligible strength, significantly improved the performance of dangerous buildings. Many of these design decisions were “made with an underlying pressure from the client to minimise the cost of intervention.” [47] This lack of design integration is very apparent when looking at the strengthening of many solid masonry walls. Today, when structural interventions are more comprehensive the question of design/aesthetic is even more pronounced, especially in the case of heritage buildings.

“Appropriateness of Seismic Strengthening Interventions in Heritage Buildings: A Framework for Appraisal”, is a paper by A. G. Cattanach, G. W. Alley and A. W. Thornton, three engineers who question if structural engineers have the skills and experience to make decisions regarding the heritage implications that occur when engineers strengthen earthquake prone heritage buildings. Together with the knowledge gained about the methods of strengthening required for medium rise unreinforced masonry buildings, this framework will be used to inform a set of structural design considerations that highlight the key aspects that need to be considered in the strengthening process.

“Strengthening is a complex art and, especially for a heritage building, should not be merely the insertion of a new modern building’s structure inside an old.”[48] Cattanach, Alley and Thornton have provided a framework to measure the appropriateness of the structural intervention. The framework assesses the suitability in relation to six criteria. Positioning, detail, current load path, reversibility, transparency and best current practice.

47 Cattanach, A., Alley, G. & Thornton, A., 2.
48 Ibid.
3.2.1 STRUCTURAL DESIGN CONSIDERATIONS

Initial Assessment [By Engineer]

- Visual Assessment of structure including any positive detailing
- Review of past plans looking at order of structural additions

Review

- Recognising the current layers of structure and what layers are doing what in terms of structural resistance.
- Analyse what/if any structure has any heritage value - often it will be the original structure - so make best effort not to cover these.
- Look to see if structure is useless or unnecessary and can be removed.

Design/Consultation

- A consultation with an engineer, understanding what structural additions are required.
- Initial designs thinking about positioning and transparency.
- A recommendation to the engineer/consultation talking through the value of current structure and the recommendation of positions.
Maximising the use of the current structure will allow for existing beneficial strength to be used, the intervention will naturally tend to be more economic and more sensitive. Minimising changing the load path will help to keep the position/location of structure consistent – allowing more open space, which is useful when thinking about the use as a co-workspace and the future adaptability and flexibility of the building. The positioning of new structure is also important making sure heritage structure and form is not masked, covered or lost. The position of the new structure should be located to enhance circulation, not harm, it may also be used as a divider of space.

Transparency highlights the importance of distinguishing between what is old and what is new. Historic details should be identified and special care should be taken to ensure minimal intervention with these elements. Any intervention should be designed in accordance with the criteria identified in the heritage design considerations. To allow the building to be read as a build-up of layers, transparency in detailing – through the separation in material, technique and/or form should be applied. The use of the best current practice will help with this as materials and technology naturally evolve with time.
3.3 HERITAGE

The strategies of conversion and intervention outlined by Brooker & Stone, Jäger and Cramer & Breitling will be used to clarify the adaptation process. The heritage considerations look to combine these strategies with the rules and regulations around heritage buildings set out by the Wellington City Council in the District Plan. The analysis of Brooker & Stone, Jäger and Cramer & Breitling’s strategies of conversion and intervention reveal the importance of the original building’s past. Both strategies look at the opportunity of adaptation to enhance or activate the potential or repressed meaning of place. This emphasizes the importance of understanding the building, its past and its development over time. An in depth analysis of the building will be the first step in this guide. The next step looks at the opportunities of a seismic upgrade, questioning what needs to be changed and thinking about what impact this will have on the current building. Next comes the design of the adaptation to the current building. This design will then be critiqued with the same criteria looking now at the relationship of the old and new in terms of scale, proportions, material and form.

3.3.1 HERITAGE DESIGN CONSIDERATIONS

Recognize what is important about the current building

Scale
Proportions
Material
From
Respects the historic or other values for which the building is listed.

What needs to be changed?

Re Design Adaptation

Review Adaptation with same criteria

Fig 3.17. Heritage considerations flow chart
Fig 3.18. (Next) Scale in context, scale is the relationship of parts of a building to its whole and the relationship of a building within its context
Fig 3.19. (Next) Proportions in context, proportional horizontal and vertical distribution helps to establish a building's scale
Fig 3.20. Form in context, the overall form should remain consistent in relation to its context
Fig 3.21. Material in context, material should be analysed recognizing what is original and what is new
It is important that the aspects of scale, proportions, material and form are analysed in both the individual building and its context, looking at both the exterior and interior of the building. An important resource for all of Wellington’s heritage buildings is the Heritage Building Inventory website.\(^{50}\) This resource analyses every heritage listed building in Wellington’s district plan and gives information about the building including, most importantly for this research the reason for listing.


Fig 3.22. Individual building analysis, the individual building should also be analysed in terms of scale, proportions, form and material.
3.4 CONCLUSION

The initial design considerations were developed in the abstract in order to gain a clear understanding of the most important aspects of each of the key components of program, structure and heritage. However, it is important that the future design looks at how to tackle all of these components together. The development of an integrated framework expands on the current design considerations and provides a clear guideline of how to adapt one of Wellington’s earthquake prone heritage buildings to a co-workspace.
FOUR: INTEGRATED FRAMEWORK
The knowledge gained from the literature review in Chapter Two as well as the developed design considerations, identifying the significant issues of each of the key concepts of program, structure and heritage from Chapter Three are synthesised into an integrated framework. This framework aims to be used as a guide for the adaptation of one of Wellington’s earthquake prone heritage buildings to a co-workspace. This framework links the three key components of this research - program, structure and heritage - together with site in order to create a clear guide for the adaptation process.

4.1 STEP ONE - ASSESSMENT

The first step of the framework looks to recognize what is important about the building. Care should be taken to not to destroy or mask these features wherever possible. Important features of the building may be interior or exterior, they may be a part of the individual building or features of the building that is common to its context. The following criteria will be used to determine what is important about the selected building.

4.1.1 HERITAGE VALUE CRITERIA

Scale

Scale is the relationship of parts of the building to its whole and the relationship of a building within its context. The building should be analysed to recognise what aspects are positively contributing to create a defined scale within the façade and the building within its context.

Fig 4.01. Scale
Buildings are scaled vertically by the number of floors, often expressed visually through obvious floor plates or lines of windows. Horizontal scale is achieved through the expression of structural elements supporting the floors. Historically these were close together because of spanning limitations of available materials. The breaking down of facades into smaller consistent modules along with the inclusion of verandas encourages a human scale.

PROPORTIONS / MODULATION
Proportional vertical and horizontal division help to establish a building’s scale. A lack of modulation causes flat, featureless, uninteresting facades. Buildings can be modulated horizontally by verandas, bands of windows, and decorative cornices. This often can create a clear base, middle and top. It is important that such proportions are identified and maintained. Vertical modulation occurs from columns and pilasters which extend from the top of the veranda up the building, it is the repetition of these elements along with the consistent spacing of windows that creates a rhythm. This rhythm is an important feature of the individual building façade as well as acting as a unifying feature of the streetscape.

Windows are another feature that aids in modulating a building. The orientation of windows are predominantly vertical. They are arranged symmetrically on the façade, often grouped in twos or threes. The alignment and repetition of windows helps to set up a strong vertical rhythm across the façade. Due to the thickness of the walls, windows become punctuated openings emphasising the solidity of the walls. These are further emphasised by substantial mouldings around the windows and doors. These features should be recognised and recorded.

Fig 4.02. Proportion/Modulation
MATERIAL
Material, colour and texture should be analysed, in terms of what is original and what is new. Where possible any flawed heritage material should be repaired rather than replaced. Often inconsistent materials – such as out of place modern materials including aluminium shopfronts will highlight out of character harmful additions, that should be recognised and removed.

FORM
The overall form should remain consistent in relation to context. Are there any features within the context that should be retained such as verandahs or balconies? Do shop-fronts / neighbouring buildings align to a consistent line on the footpath?
CONTEXT

It is also important to recognise if the building is part of a heritage area. If so it is important to recognise any key features that are unique to these buildings. Important aspects of site shall also be considered such as the building’s relationship to the street and public space, as well as important entrances and exits.

WHY WAS THE BUILDING LISTED?

Looking at the Wellington Heritage Inventory\(^{51}\) will help to clarify why the building was listed, noting exactly what aspect of the building have heritage significance. The heritage value criteria is focused on the exterior of the building and the building in context, however if there are any significant features within the interior these will be highlighted in the heritage inventory. This resource may also reveal previous buildings that have been on the site, as well as historical, social, architectural or technological significance relating to the building and its previous occupants. This information will be useful to inform the future design adaptation.

\(^{51}\) Wellington City Council, “Wellington City Heritage.”

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Fig 4.05. Context
Fig 4.06. Why was the building listed?
4.2 STEP TWO - CHANGES

The next step of the framework is to recognize the potential of the current building. In order to understand what changes are possible, there needs to be a clear understanding about what is required in a co-workspace. This is set out with the aims of co-workspace, clarifying what the adaptation is working towards.

4.2.1 AIMS OF CO-WORKSPACE

ENHANCE PRODUCTIVITY
The workplace should be designed to enhance the productivity of all workers. This not only includes the basic requirements like thermal comfort, visual privacy, air quality, acoustic comfort and natural lighting but also the location of activities to minimise disruption where necessary and enhance collaboration with others.

SPATIAL FLEXIBILITY
Due to the frequent changes in office design in terms of both organisational structure and layout, it is important that buildings are able to facilitate these changes with minimum disruption. The building should be designed to maximise spatial flexibility. This is best achieved with large uninterrupted floor plates that can accommodate a conversion from cellular offices to open plan layouts.

Fig 4.07. Enhance productivity
Fig 4.08. Spatial flexibility
4.2.2 OPPORTUNITIES?

Questions should be asked about the current space such as:
- What is hindering the use as a co-workspace?
- Assessment of current structure and structural weakness: are there structural members hindering the future layout, circulation or entrance into the workplace?
- Is the space comfortable to inhabit?
- Are there any harmful additions that have occurred over time that should be removed?

Gaining answers to these questions help to clarify the issues with the current building and recognise what needs to change.

WORKPLACE FLEXIBILITY

Offices should be designed to encourage workplace flexibility, specifically having a range of workspaces suited to different activities. These activities shall be grouped in such a way to enhance productivity, as set out in the program design considerations.

ENCOURAGE INTERACTION

Interaction between employees and various user groups is key with any co-workspace. These workplaces work best when different users are able to gain support from others. People use such spaces to gain connections in various industries. The distribution of activities shall be arranged so that permanent workers, temporary workers and the public have areas to interact. Areas of the co-workspace, such as the ground floor shall be easily welcoming to the public.
4.3 **STEP THREE - DESIGN/REFLECT**

The final step in the framework incorporates these changes into a design proposition. The design will be assessed with the same criteria looking at the integration of old and new in terms of:

- Scale, specifically the relationship between individual parts of the buildings to it's whole, as well as the relationship of the building within it's context looking at both original and added material.
- Proportion/Modulation, making sure that any adaptation does not harm the horizontal and vertical proportions of the building, and any addition enhances the modulation of the facade.
- Material, any added material should be in keeping with the original.
- Form, the overall building form shall remain consistent in relation to its context, any radical adaptation shall be thoroughly justified.
- Context, any addition shall relate to not only the individual building, but also the building in context.

![Fig 4.11. Scale](image1)

![Fig 4.12. Proportion/ modulation](image2)
FIVE: FRAMEWORK APPLICATION
5.1 WELLINGTON WORKING MEN’S CLUB
1904
Fig 5.01. (Previous) Collage of Wellington Working Men’s Club building
Fig 5.02. (Right) Aerial Perspective showing location of Wellington Working
Men’s Club in Cuba Street Context.
5.2 ASSESSMENT

5.2.1 HISTORY

The Wellington Working Men’s Club is one of the most distinctive structures in the Cuba Street Heritage Area. It is comprised of two buildings designed by architects Thomas Turnbull and Son, in 1904 and 1908, for R. Hannah and Co, the hugely successful shoe manufacturer, importer and retailer. This building is part of a group of Edwardian commercial buildings on Cuba Street which demonstrate the commercial growth and building boom on the street in the 1880s, motivated in part by the introduction of a tram. This building has heritage significance and is a Historic Place category 2 building. The load-bearing brick masonry building is also earthquake prone and in need of a seismic upgrade. Due to its heritage value, need for seismic upgrading, and proximity to creative industries in Te Aro, the 1904 Wellington Working Men’s Club building was chosen as a vehicle to test the effectiveness of the framework.
Fig 5.03. (Previous) Elevation of Wellington Working Men's Club in context
Fig 5.04. Demolition of The Masonic Hotel, Cuba Mall 1979
The building to the south, located at 109-117 Cuba Street, built in 1904, was built for ground floor retail and offices above. To the north, 101-107 Cuba Street, built in 1908, was built with retail on the ground floor and a hotel on the top two levels. 107 Cuba Street became the Hotel Grand Central in 1910 which operated in the building for over 40 years. In 1954 the Hotel was converted into offices and became the headquarters of the Totalisator Agency Board (TAB). In the 1960s both buildings were bought by the Wellington Working Men’s Club and Literacy Institute – a club formed in 1877 by working-class British immigrants.

The two buildings shared a central wall, which was adjusted in 1908 to allow access between the two buildings. The Masonic Hotel, also designed by Thomas Turnbull, immediately north of 101-107 Cuba Street, also shared a wall with the buildings. In 1979 the Masonic Hotel was demolished, including the shared wall. This resulted in the strengthening of the 101-107 building. In 1997 the north building was converted into apartments, while the smaller southern building remained the Working Men’s Club. In 2009 the unused club rooms were converted to a city campus for Whitireia Polytechnic, but they were vacated in 2011 when it was found that even though the building had been renovated and strengthened, the façade was potentially an earthquake risk. The building now has shops on the ground floor, with a mixture of offices, apartments and vacant space above.

The building’s size, consistent within its context, should be retained as well as the repetitive shop-front scale.

The repetition of vertical structural members shall be retained and celebrated, as well as the repetition of the vertical arched windows. Currently the vertical emphasis is being lost behind the verandah and the reading of the vertical structural elements in not continuous below. The clear separation of a base, a middle and a top should also be retained, however this could be further strengthened as currently there is little connection between the base and the rest of the building.

Fig 5.05. Scale in context
Fig 5.06. Proportions/Modulation in context
The building’s form is sympathetic to its context. Important features of the context should be recognized and retained, such as the canopies - however in this case, the verandah is a bulky replica of the original, which could easily be removed and replaced.

The exterior has a rendered brick finish which is consistent with many of the surrounding buildings. The ground level shopfront materials are inconsistent and out of character and should be replaced.
Fig 5.09. Pedestrian Activity on Cuba Mall
Wellington Working Men’s Club is part of the Cuba Street Heritage Area. This area is important for its large and diverse collection of Edwardian buildings. The walkability of Cuba Mall is an important consideration in the development of the design as well as the characteristic of a public ground floor which is typical to most buildings in Cuba Mall.

Fig 5.10. Analysis of Cuba Mall Public Ground Floors
[1904] Verandah Added

[1938] Verandah Added

[1944] Parapet and Verandah Removed

[19XX] Shop-fronts Resigned Multiple Times

[1998] Verandah Addition
5.2.2 BUILDING EVOLUTION

Analysis of the Wellington Working Men’s Club Buildings over time shows that the majority of the distinctive heritage features are above the first level. The shop fronts have changed over time, and the bulky verandah is an out of character addition; “the building is unfortunately disfigured with an inappropriate and bulky modern verandah at street level which detracts from its value in the streetscape.” As well as the removal of capping and pediments over the main entrance in 1944, there has also been general deterioration over time causing the decay and removal of some detailing along the façade. The important features lie mainly in level one and two of the façade, allowing opportunity for the redesign of the ground level of the façade.

“Wellington Working Men’s Club.” In Wellington City Heritage

Fig 5.11. (Left) Evolution of Wellington Working Men’s Club façade
Fig 5.12. Analysis of Wellington Working Men's Club's elevation
5.2.3 HERITAGE VALUE

The Wellington Working Men’s Club is listed as a heritage building on the Wellington District plan. It is also part of the Cuba Street Heritage Area and it is listed as a category two building by the New Zealand historic places meaning it is a place of historical or cultural significance or value.\(^{54}\)

This building is comprised of an ornate pair of Edwardian neoclassical buildings which have architectural value for the rich detail and elaborate decoration on both of the façades. The Wellington Working Men’s Club is one of the finest large Edwardian Buildings in the Cuba Street Heritage Area. The 1904 building is more heavily detailed and features distinctive recessed arches in the centre of the façade. The building has many classical features such as rustication, pediments, urns, balustrades, intricate keystones and arched windows.\(^{55}\)

The building has historic value for its association with businessman Robert Hannah, and his shoe enterprise. The building is also associated with the commercial growth of Cuba Street and its subsequent wealth and building boom throughout the early 1900s resulting in the construction of a number of Edwardian commercial buildings. The building is also important due to its association with the architectural firm Thomas Turnbull & Sons as well as its connection with the Wellington Working Men’s Club and Literary Institution who occupied the building for a number of years.\(^{56}\)

\(^{55}\) “Wellington Working Men’s Club.” In Wellington City Heritage.
\(^{56}\) ibid.
5.3 OPPORTUNITIES

REMOVAL FROM REAR ADDITION
The separation of the original building from the 1978 six story addition at the rear, so the building can exist on its own.

REMOVAL OF PARTITIONS
The current interior partition walls need to be demolished in order to make the building suitable to contemporary functions.

INSERTION OF NEW STRUCTURE
A new structural scheme needs to be designed and inserted into the building in order to provide seismic resilience.
CONNECTION AND CIRCULATION

As discovered in the programmatic design tests a central circulation space will be inserted to increase the connection of users throughout the building.

ENTRANCES

An adaptation of the ground floor entrance will be informed by both the history and evolution of the building as well as the new programmatic requirements within the space.

DAYLIGHT

The adaptation of the current roof to include skylights will help to increase the natural light into the space.
5.4 DEVELOPED DESIGN

The developed design attempted to address these opportunities suggested by the framework.

The main focus on the façade was the retention of the three clear parts of the building including a base, a middle and a top and the redesign of the ground floor entrances. The lines of structure are also brought down to the ground to maintain the vertical modulation of the façade, and help to maintain the consistent shop front scale. This also helps to link the base to the other upper parts of the building.

Fig 5.19. Exterior perspective, after redesign with the framework
EXISTING STRUCTURE
MAIN STRUCTURE
SUPPORT STRUCTURE

- Existing Timber Trusses
- Steel Moment Frames
- Cross Bracing to Provide Diaphragm

- Saw Cuts in Existing Brick Walls
- Steel Cross Bracing
- Steel RHS Supporting Facade
5.4.1 STRUCTURAL ADDITION

Two layers of structure were added to the building, the first to support the current building, specifically the masonry façade and exterior walls. The second to increase the seismic resistance. Moment frames were chosen as the method of strengthening along the length to allow for large open spaces. Braced frames were used in the opposite direction to sympathise with the stiffness of the current exterior brick walls. Steel rectangular hollow sections were added along the brick wall, at the mid span of the braced frame to support the masonry walls. Cross bracing was also added under the floors to provide a diaphragm at each level.
5.4.2 CO-WORKING PLANS

The structural grid helped to inform the layout of activities within the building, with a transition from a public ground floor to a more private second floor.

5.4.3 PROGRAM LAYOUT

This diagram shows the arrangement of activities within each level.

With an event space and café on the ground floor, hot-desking, a break area and meeting rooms/spaces on first floor and individual and team workspaces on the second floor.
5.5 WORKER INTERACTION

This shows the relationship of the users groups, specifically the interaction between the permanent and temporary users as well as the public. This also shows the central void and staircase which is used as a central connection device within the building.
Fig 5.24. Adapted Wellington Working Men’s Club Building in its Cuba Mall context
Fig 5.25. (Top) Proposed ground level cafe, looking out to Cuba Mall
Fig 5.26. (Bottom) Proposed ground level view from cafe towards event space
5.5.1 REFLECTION

Reflecting on the application of the framework, the process of applying the framework to a test building was successful. Following the three steps of the framework allowed for the important features of the building, namely the first and second story of the façade, to be recognized and respected as well as the form of the building within its Cuba Mall context, such as the characteristic of a public ground floor, the overall continuity of the street wall line created by the building facades as well as the common features of Cuba Street buildings including an ornamented facade with a parapet, and a well-glazed shop-front. The second step of the framework gave a clear set of goals for the adaptation including; the removal from rear addition, the removal of partitions, the insertion of new structure, the increase of connection and circulation within the building, the adaptation of the entrances into the building and increasing the daylight in to the building.

Fig 5.27. Level One workspace, intended for temporary workers, showing new staircase and void, which increases the internal connection and circulation within the building.
Fig 5.28. *(Top)* Level Two workspaces intended for more permanent workers
Fig 5.29. *(Bottom)* New skylight at level two increasing the daylight in the building
Through the careful integration of old and new, these goals were successfully applied. The insertion of new structure in combination with the separation of the building from the 1980s rear addition means the building can exist on its own, even if the rear building is torn down. The removal of partitions opened up the interior and the addition of a central staircase with a void through the middle provided a central circulation path through the building and increased the connection between each level. The redevelopment of the ground level facade opened up the ground floor, creating a stronger connection with Cuba Mall. The insertions of skylights and a central void increased the daylight into the building, making it a more pleasant space. Thinking about the success of the overall design, the facade was redeveloped while remaining sympathetic to its heritage elements, and the interior was successfully laid out for use as a co-workspace.

CRITICAL REFLECTION

Reflecting on the development of the framework and the resulting design there are also few critiques. The most important is the lack of integration between program and structure. This can be explored through the investigation of multifunctional structure, looking at how the insertion of new structure within existing building form can do more than just strengthen the building. This approach is supported by reference to the writing of Stewart Brand and his ideas about how buildings learn, especially the concept of the layers of a building. Attention to Brand’s ideas of layering will help to link program, structure and heritage into the design.
SIX: MULTIFUNCTIONAL STRUCTURE
6.1 MULTIFUNCTIONAL STRUCTURE DEVELOPMENT

6.1.1 MODEL TESTS

The next phase of design involves an investigation into the possibilities of multifunctional structure. This process aims to link two of the major research concepts: program and structure. It involves preliminary design investigations into the ways in which different structural systems (including moment frames, braced frames and shear walls) can provide more than just structural strength in a building. These design exercises look specifically at how functional elements can be integrated into the structure in order to enhance the space for use as a co-workspace. These explorations also analyse the permanence of such systems, looking at the flexibility of each proposed design and thinking about future adaptability.

Fig 6.01. Initial sketches exploring possible functions that could be given to new seismic structural elements
BRACED FRAME

The first test explored braced frames, looking at additions ranging from systems that create a partition between the sides of the structure, to systems designed to house storage. Planter systems were also explored, using the structure to support the plant’s growth as well as a hammock system.
MOMENT FRAME

The moment frame additions explored partitions, standing desks, additional seating, hanging swing-sets and mobile phone call booths.

Fig 6.03. Models exploring possible functional additions to moment frame structural systems and exploring possible materials such as plywood, tension cable and felt
Shear wall additions explored functions such as shelving, acoustic insulation, picture frames and additional seating which is embedded within the wall and can be taken down when required.
6.1.2 POSITIONING

There are two clear locations when exploring the positioning of functional structure. These are lateral and longitudinal, in the direction of the structural frames and between them.

Fig 6.05. Diagrams exploring location of possible functional additions
6.1.3 FUNCTIONS

Analysing the preliminary exploration models there were five possible functions, of multifunctional structure. These are;
- Storage
- Mask
- Partitions
- Seating
- Acoustic separation

Fig 6.06. Functions of multifunctional structure
Fig 6.07. Planters hooked into a braced frame
Initial models explored the following functions: acoustic louvres acting as a partition between workspaces built into a moment frame; sliding shelves in a moment frame; two way shelving with clear panel for visual connection; and lightweight seating stored within a moment frame.

Fig 6.08. Multifunctional structural models exploring the five functions.
Fig 6.09. Model explorations looking at how structure can be adaptable, additions including movable shelving, sliding shelving and stackable seating.
Adaptability was an important consideration in the development of these systems. It is important that whatever is added is not a static and permanent addition.

Fig 6.10. (Top two) Further models exploring a sliding, roll up / roll down screen supported between lines of structure
Fig 6.11. (Bottom) Model exploring adaptable seating
DOES NOT HARM THE STRUCTURAL PERFORMANCE
The addition does not create a strong infill panel

HAS SUFFICIENT STRENGTH
Prevents a failure from face loading

ADAPTABLE
Recognizes that the way the building is used will change over time

Combining what was learnt from the model tests with further research into structure, a set of rules was established to act as a guideline in the design of multifunctional structural systems. These rules include:
- Designing a system that does not harm the structural performance of the building; specifically the addition does not create a strong infill panel.
- Designing a system that has sufficient strength and will not fail under face loads.

Fig 6.12. Diagrams illustrating the rules of multifunctional systems
- Designing a system that is adaptable and recognizes that the way the building is used will change over time.
- Designing a system that fits within the structural grid and does not harm the layout and circulation.
- Designing a system that is flexible and can work with the variance in structural systems throughout the building.
Fig 6.13. Initial sketches exploring the application of multifunctional structure in the adaptation of the Wellington Working Men’s Club to a co-workspace
These rules were tested once again on the Wellington Working Men’s Club Building. Initial sketches explored possible options for multifunctional structure within a co-workspace, looking at additions that would aid in the use of the space for co-working.
Three types of systems were designed, with each system performing a different function. These are;
- Planter – a system designed to mask obtrusive structure
- Storage and seating – a system that provides lightweight additional seating when required, as well as cubbies for storage.
- Partition system – this system is made up of a sliding rail supported on the flanges of the moment frame beams. Roll up partitions can clip in to the rail and be adjusted to suit.

Fig 6.14. Planter system, using structure to support the growth of plants and using plants to mask the out of character structure
Fig 6.15. Seating system within a moment frame with removable lightweight seats that fit in purpose-built plywood cubbies
Fig 6.16. Partition systems, an example of a system between structure made of roll down screens that are supported on and can slide along the flanges of moment frame beams.

Fig 6.17. (Next) Plans of Wellington Working Men’s Club showing location of added multifunctional structural systems.
Sample layout showing how these multifunctional structural elements might be developed.

Planters are added to mask most of the out of context braced frames along the exterior walls of the building. Storage and seating is added to the event space and behind the stairs on the ground floor as well as around the meeting room on the first floor. Finally rails are hung between the lines of steel structure on the first floor and between the existing timber trusses on the second floor. The partitions can be adapted to provide acoustic and visual privacy when required.
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6.2 CONCLUSION

The framework that clarifies the process of adapting Wellington’s earthquake prone heritage buildings to co-workspaces can be used in conjunction with the set of rules that guide the application of function to structure to adapt any one of these 125 earthquake prone heritage buildings in Wellington. By following these guidelines many of these buildings will be given a new purpose, escaping demolition and allowing Wellington to retain a larger piece of its built heritage.

Testing the framework for the adaptation of Wellington’s earthquake prone heritage buildings to co-workspaces and the rules of multifunctional structure on a single test case, the Wellington Working Men’s Club Building, was a limitation of this research. However, because both the framework and the set of rules were developed with each type of structural system rigorously explored, it is expected that both systems will be relevant and useful resources in the adaptation of other buildings.

This research focused on Wellington’s earthquake prone heritage buildings. However (with minor adjustments) the framework and set of rules will be relevant in the adaptation of any of New Zealand’s earthquake prone heritage buildings to co-workspaces. This issue is not just isolated in Wellington and buildings throughout the country need a reason/purpose to escape demolition: New Zealand has a large number of buildings in a similar situation. With the new national system which came into effect in July 2017,\(^\text{57}\) a larger number of earthquake prone buildings throughout the country need to be strengthened or demolished within 15, 25 or 35 years (depending on their location in high, medium and low risk areas).

Earthquake Prone Heritage Building (125)

Earthquake Prone Building (630)
The ideas explored in this thesis, looking at giving additional functions to structure were specifically designed for co-workspaces, however these ideas could be explored for different programs such as housing and/or retail. The design systems; planter, storage + seating and partition would all be appropriate systems in these cases. This means that the multifunctional additions will be beneficial even if the use of the building changes. In the case of both housing and retail an additional intermediate partition would need to be developed, one with acoustic insulation properties since apartments and stores are both more cellular than co-workspace. However, in a broader sense, the set of rules that guide the application of function to structure are still relevant when dealing with different programmatic requirements.
SEVEN: REFERENCES
7.1 REFERENCES


Cited in Brand, 104.


7.2 LIST OF FIGURES

All images presented as part of the November Review are marked with an asterisk.

All people and plant illustrations are adapted from Kate Puglsey illustrations.

Fig 0.01* Aerial views of Wellington’s earthquake prone and earthquake prone heritage building Authors Own

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Adapted From: Early Office Museum. Sales Department General Office & Company. (Chicago, Illinois, 1910)

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Kallen, L., Redefining (and Redesigning) the Way We Work Works. (New York, 2016).

Fig 3.02  Bond Collective interior

Fig 3.03  Biz Dojo interior
Nickelchok, K., Biz Dojo Wellington. (Wellington, 2015).

Fig 3.04  Co-working amenity icons
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