BUILDING REUSE AND SUSTAINABLE BEHAVIOURS

Nurturing occupant behaviours towards a sustainable reuse of existing buildings

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ABSTRACT

This proposition will address the identified problem of deteriorating built environments through designing a sustainable reinvigoration. This type of reinvigoration instils not only the value of sustainability in reuse, but is known to succeed when designs result in the 'triple bottom line' effect of increased social, economic, and environmental values ("Triple Bottom Line", 2009).

This proposition intends to explore a fourth bottom line. One to engage with people outside of the site, to extend beyond the prescribed boundaries and behaviours, and to go away with people within the mind of the beholder. To introduce the fourth bottom line is to address the psychology of sustainable practice surrounding the built environment. Integrating this principle will deliver a design response that aims to be sustainable, and regenerative in the teachings and demonstrations that can provide inception of sustainable practices within the wider society.

This proposition will explore a discussion between two pre-existing enquiries;

- // sustainable reclamation of existing built environments

- // pro-environmental behaviour and sustainable psychologies

The existing built environment along the western shore of Watts Peninsula, known as Shelly Bay, was home to the New Zealand Defence Force Base for over 125 years. Since its retirement from government use in 1995, its re-development has been setback by policy, a division of land tenure, and member approval from its governing body (Jackman, 2014). Since the retirement, the infrastructure and existing built environment have been progressively deteriorating.

A sustainable reinvigoration of this site will succeed in savings of the existing culture, expenses and heritage while positioning an adapted environment that could be utilised by the wider society. Moreover, this proposal could be designed to inform sustainable psychology while achieving increased or realised social, economic, and environmental values.

This design as research thesis will explore the existing site to determine contextual and psychological effects that are influencing the degradation of the environment.

The identified problem(s) will then provide parameters for the designed reinvigoration and through an analysis of the pre-existing principles, a proposed design criterion will be applied to the designed concept.

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PREFACE

The question explored in this thesis is;

how can one architect an existing built environment for an adaptive reuse that nurtures and promotes pro-environmental behaviour?

In this proposal, *sustainable* is defined as;

The ability to be sustained within the capacity of the supporting ecosystem without constraining future requirements or adaptability and achieving economic prosperity, environmental quality, social equity and psychological empowerment.

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INTRODUCTION

This introduction outlines identified problems with the existing building stock and will explore the discussion and potential of instigating behavioural adjustments as a tool for improving building performance.

The intentions of this investigation are presented and developed as a series of objectives, which are endeavoured to achieve the design aim. These objectives are used to frame the investigation throughout each subsequent chapter.

The methodology and scope are discussed to introduce how this investigation is researched through one designed response within one existing built environment.

DEFINING THE PROBLEM

The problem is assessed to arise from three areas. Firstly, our current practice within the construction and demolition industry. Then, our current approach to mitigating building energy use and lastly, our current attitudes and behaviour towards building use.

The former defence force base at Shelly Bay is comprised of several purpose-built buildings that are semi-derelict due to lack of use and maintenance.

The current practice of reusing this site would typically be to demolish the existing buildings and construct new ones from newly manufactured or sourced materials. The existing materials will not have reached their minimum life span of typically 100 years (John and Buchanan, 2013, 37).

The current approach, alternatively to demolition, could be to construct a new mechanically serviced envelope inside the shell of the existing building. This proposal separates users from their environment and does not typically address energy consumption, constituting to the built environments 30% take of global energy (IEA and IPEEC, 2015, 17).

Lastly, our current attitude towards sustainable buildings could be to construct the adapted or new building to meet sustainable ratings by generating renewable energy on site, employing sustainable materials and passive techniques of environmental control. However, our current attitudes remain unchallenged, and we would still consume energy comparably with the former option.

These are the defined problematic areas that will be explored for possibilities for designed improvement throughout this thesis investigation.

FIGURE 1.01 // PHOTOGRAPH SHOWING EXISTING SHED EIGHT BUILDING OF SHELLY BAY

EXISTING BUILDING STOCK

A prevalent point of current discussions surrounding the existing built environment is about the amount of material that ends up as waste in municipal landfills (BRANZ, n.d.). The Ministry for the Environment recorded 2.5 million tons of solid waste was disposed of in 2010, of which up to 20% originates from the construction and demolition industry (MFE, 2011; BRANZ, n.d.).

An effective technique of reducing demolition waste by reusing and recycling materials is through deconstruction. Deconstruction is said to have 'two-fold' benefits, as described by Storey et al., as it "seeks to close the resource loop", and diminishes the demand on new resources (Storey, Gjerde et al., 2003, 98-99).

Although building reuse is achievable, deconstruction is restrained by a number of barriers such as; "Perception and Education, Design for Deconstruction, Economics, Industry Practice, Liability, Legislation, [and] Technical Issues" (Storey, Gjerde et al., 2003, 98-99).

In understanding these barriers, it becomes evident that architecture has the potential to significantly influence a number of these barriers by lending itself towards a system design approach over a single-use approach. This is significant throughout this investigation by drawing significance to the end-of-life purpose of building elements in addition to the reuse of existing building materials.

FIGURE 1.02 // EXISTING BUILT ENVIRONMENT OF WELLINGTON CITY

The existing built environment, both locally and globally, is being discussed with emerging concerns. This stems from revelations regarding building energy use and energy goals, most of which are presented as guidelines or governing regulations, acts, and policies. Programs such as; Living Building Challenge; GreenStar; LEED; BREEAM, to name a few, push the designed environment towards energy efficiency and regenerative design. When the prescribed program criteria are achieved by an architecturally sustainable design, the acclamations fall short on two counts.

Firstly, one new 'star'-certified building is often perceived more as a heroic milestone, than a demonstration for others to follow. Ravetz explains that globally, the existing building stock is said to renew at a rate of 1-2% per year, and locally, the Wellington City Council provides a 'worst-case' estimation of a 3.6% renewal rate (Ravetz, 2008, 4462; Brown, 2016; Enisha, 2016). Relative to the aforementioned incentive programs/policies, there is the indication that up to 75% of the buildings to be assessed by the program criteria within our future lifetimes are already in existence today (Ravetz, 2008, 4462). This is fundamental in demonstrating the importance of revitalising the existing building stock in order to make it economically viable to maintain and energy efficient to run.

Secondly, there is a common misconception that sustainable buildings and innovative technology will resolve the issues surrounding building energy use, which is reported as being over one-third of global energy consumption (IEA and IPEEC, 2015, 17). Understanding sustainable buildings to be merely sustainable objects until they are considered respective to the uses, or the users, is fundamental in demonstrating the correct conception that needs promotion; 'Buildings don't use energy; people do' (Janda, 2011, 15).

This is an integral part of this investigation, which will explore how to design buildings to engage users to act sustainably.

PRO-ENVIRONMENTAL BEHAVIOUR

Designing to motivate and nurture pro-environmental behaviours will be critical in developing an intervention that successfully engages users and delivers a sustainable sociology. Furthermore, developing an understanding of influences of pro-environmental psychology can also assist in the critical evaluation of case studies and literature opinions on this topic.

The field of discourse surrounding human relationships with natural and built environments is regarded as 'environmental psychology', which by definition is the "branch of psychology where the effects of the physical environment on behaviour and welfare [are] studied" (Pam MS, NCSP, n.d.).

The relationship between environmental psychology and architecture and construction became more frequently discussed with the increasing awareness of environmental degradation from gas emissions, energy consumption, and overpopulation (Kollmuss and Agyeman, 2002, 240).

Since the 1970s, a number of progressive initiatives have developed tools and design aids to surpass 'sustainable' practices and introduce 'regenerative' ideologies (McDonough and Braungart, 2013, 8).

These initiatives developed a new field of environmental psychology that encourages human behaviours towards a bio-centric attitude, which seeks to rectify and improve existing environmentally degrading values and practices. This field of discourse became known as 'pro-environmental psychology' and is defined as resulting in "behaviour that consciously seeks not only to eliminate the negative impact on the environment but also to make positive impacts through one's actions on the natural and built environment" (Grzywa, 2015, 55).

The current state of architecture is suggested to reflect an anthropocentric attitude, in which humanity is dominant over nature. Our designed environment has abused industrialisation, “capitalising on [the] availability of cheap energy to provide climate control, ventilation and artificial lighting”, allowing our buildings to present as sealed envelopes, completely separate to the exterior environment and requiring little or no interaction from the user (Grzywa, 2015, 23). Innovations within the construction industry shift towards mechanisation and performance monitoring which further remove the user from acting independently (Kantrowitz, 1984, 29).

In understanding that building users are more significant in achieving sustainable practice than sustainable buildings, it becomes increasingly evident that existing behaviours, which adversely affect the environment, are required to change. Exploring the psychology of behaviours and their association with the environment will become an integral part of this thesis in investigating how design can influence, nurture and challenge existing values and attitudes towards pro-environmental behaviour.

FIGURE 1.03 // ENCOURAGING PRO-ENVIRONMENTAL BEHAVIOUR

RESEARCH INTENTION

Through explorative design as research, the aim of this research is to answer the following question:

How can one architect an existing built environment for an adaptive reuse that nurtures and promotes pro-environmental behaviour?

This research will address issues restricting pro-environmental behaviours, and, by idealising the existing purpose-built and poorly performing buildings of Shelly Bay as a material resource, will deliver a psychologically engaging architectural intervention.

The research intention extends itself to a designed program of the intervention by examining closed-loop systems in an application.

Through design as research, the objectives of this thesis extend to;

- / understanding influences of, and nurturing pro-environmental behaviours
- / innovative adaptation of existing built environment to increase usability and performance
- / challenging existing societal norms

STRUCTURE AND METHODOLOGY

This thesis is presented in two parts, and nine chapters.

Research about design is largely used to frame the bulk of *Part One: Informing the design* as it sets the context of this thesis within topical discourse.

Research *for* design and research *about* design are initially undertaken simultaneously through gathering information specific to the site and to the pre-existing research enquiries. Research for design develops from a thorough assessment of the existing built environment and environmental psychology to identify the physical and discarnate materials required to be challenged, adapted and intervened on. A variety of theorists and existing projects are critically reviewed to identify areas to develop, challenge, or disregard creating a criterion and a set of tools to be explored through design.

Research *through* design is tested and portrayed throughout the *Part Two: Design* component of this investigation. The design investigations are guided by the developed criterion, which is informed by reviews of the existing site, literature discourse, and case studies.

These are explored through conceptual sketching, diagramming and mapping, and physical and digital modelling. Through iterative explorations of these methods, the design response is tested for its effectiveness in achieving the aims and objectives of this proposal.

SCOPE OF RESEARCH

The theoretical context of this thesis investigation is in consideration of existing built environments. The discourse of this research field has indicated that the most prevalent influences of behaviour, in regard to building use, come from contextual influences such as direct experiences, and self-concept (Kollmuss and Agyeman, 2002, 239).

For this reason, the scope of research through design for investigations of this wider concept is developed in respect of their own physical context, in a case-by-case method.

Specifically, this investigation explores the possibilities of one building, with the intention of demonstrating one approach to revitalising an existing environment in a manner that engages pro-environmental behaviour.

CONTEXT

This thesis tests the designed possibility of reinvigorating an existing built environment to nurture pro-environmental behaviours within its building users.

This context analysis evaluates the existing site, shown in Figure 2.01, to identify what influences are resulting in the degradation of the existing buildings, and what factors of the built and unbuilt environment affect the building performance by the user.

The issues discussed here will inform design opportunities that are considered to mitigate degrading qualities and accommodate for an increased use.

*FIGURE 2.01 // [TOP/ BOTTOM/ RIGHT] WELLINGTON HARBOUR/
MIRAMAR + WATTS PENINSULA/ SHELLY BAY*

HISTORY OF THE BUILT ENVIRONMENT

Miramar Peninsula was predominantly used for agriculture since its purchase from the New Zealand Company in 1839 (Blaschke & Rutherford, 2012, 23). Shown in figure 2.01, Watts Peninsula, the northern tip, was sectioned off from Miramar Peninsula and sold to the New Zealand Defence Force in 1886 (Blaschke & Rutherford, 2012, 23).

The defence force base, H.M.N.Z.S. Cook, located in Shelly Bay, was situated along the western shores and comprised of 25 separate buildings that were constructed between 1940 and 1965 (Ministry of Works, 1978) (Figure 2.02).

The New Zealand Defence Forces managed Watts Peninsula until 2008, a tenure of 123 years (Jackman, 2014). This private and militarised management of the site resulted in the purpose-built spaces remaining vacant and underutilised as a result of decreasing demand for military service.

The existing built environment presents itself in need of adaptation or reinvigoration to further utilise the buildings as a resource and to improve their current performance.

FIGURE 2.02 // OVERLOOKING SHELLY BAY AIR FORCE BASE, 1948

ACCESSIBILITY

The historical development of Shelly Bay as a high-security defence base resulted in restricted and minimal accessibility onto the site. Access is predominantly via the single road reserve, either by vehicle, cycle or on foot.

Blaschke & Rutherford identify constraints of the minimal access on site to include “storm events or sea rise may mean the site cannot be accessed from the coastal road” in addition to explaining “the current state of infrastructure, especially roads... need urgent attention” (2012, 35).

The closure of the defence base in 1995 resulted in an increase of public access and recreational activity on and surrounding the site (Jackman, 2014).

Existing public transport networks do not provide direct access to the site, however nearby bus stops are within 30 minutes walking distance either around the shoreline or down existing bush tracks across council reserves (Metlink, n.d.).

The ease of accessibility to the site is poor, indicating the revitalization of the built environment should extend to integrate this to ensure viable access and use of the designed intervention.

*FIGURE 2.03 // [TOP/ LEFT/ RIGHT] - PHOTOGRAPHS SHOWING:
THE ACCESS ROAD/ INFORMATION SIGN/ OLD MILITARY ROAD*

PUBLIC AMENITY

The corporate management of the Shelly Bay Defence Force Base made few changes that influenced the public amenity across the site. Since the purchase of Shelly Bay in 2008 by the Port Nicholson Block Settlement Trust as part of a Treaty of Waitangi settlement, there has been a small increase in public amenity (Blaschke & Rutherford, 2012, 27).

The new tenancies accommodate several artist gallery workshops which are open by appointment, and there is a popular café on the site (Figure 2.04, & 2.05). There are no utilities, such as public bathrooms or drinking fountains, and only a few public amenities, such as seating, and rubbish bins around the site.

This lack of public amenity influences user behaviour when at the site, as it presents as unaccommodating and private (Gehl, 1987, 14). Both these tenancies and amenities provide only a small amount of encouragement for users to engage with the wider site.

*FIGURE 2.04 // PHOTOGRAPH OF
SHELLY BAY PUBLIC SPACE*

DAILY PROGRAMME

The private and commercial enterprises restrict daily life around the site as the hours of use are directly influenced by the business programmes. The several gallery workshops vary in opening hours, but do not open prior to 9 am, and close no later than 5:30 pm, with a few that open by appointment only.

There is a popular Café, which boasts flexible opening hours at either end of their typical 8 am to 5:30 pm daily life.

These tenancies dictate the daily life around the site, as with few public amenities and minimal accessibility, the possibilities of optional and social activities are restricted, impeding on the potential use and performance of the buildings (Gehl, 1987, 14).

This indicates the opportunities for the designed intervention to expand the daily life by a suggested program, enabling the site and the buildings' use to be extended, increasing the potential performance of the existing built environment.

FIGURE 2.05 // PHOTOGRAPH OF
SHELLY BAY GALLERIES

PUBLIC AND THE ENVIRONMENT

Blaschke & Rutherford describe much of the site to have “many characteristics similar to the Wellington Town Belt and Outer Green Belt”, with any modifications being few and of a small scale that the natural materials and qualities are dominant (2012, 29). In their 2012 report, Blaschke & Rutherford exclaim that “the site has a number of advantages for environmental restoration”, alluding to the possibilities for a revitalizing design to extend into and integrate with the natural site (32).

This is a value inherent to the site that holds significant influence in challenging and changing behaviours concerning the natural environment. Integration with natural cycles and processes will aid in challenging existing societal norms and increase awareness of user influence.

Currently the existing built environment appears to have little integration with the site. The existing wharf is cordoned off, restricting access to the harbour. Around the remainder of the site, concrete embankments and boulder retaining walls have been constructed, as shown in Figure 2.06. These improve maintenance by mitigating effects of erosion, however they impede the public's access and ability to experience the harbour environment.

FIGURE 2.06 // [LEFT/ RIGHT/ BOTTOM] - PHOTOGRAPHS SHOWING: SINGLE DESIGNED HARBOUR ACCESS/ CONCRETE EMBANKMENT/ CORDONED OFF WHARVES

DESIGN OPPORTUNITIES

This context analysis identifies critical influences and qualities that affect building use and user performance in and around the existing built environment. These influences inform opportunities for the designed intervention, which include;

// The existing purpose-built warehouse buildings are restrictive for re-use by programme adaptation due to the large undivided volumes, however, the existing materials are considered to be suitable for reuse.

// Accessibility into and around the site, and specifically around the designed intervention is essential in ensuring occupancy of the programme.

// Increase the daily programme to improve building use and allow for opportunities to further engage users and influence occupant behaviour.

// Increase the public amenity throughout the designed response to encourage building use and create opportunities for sustainable occupant experiences.

// Design for integration with the natural environment to provide opportunities to engage users with natural cycles and processes.

PROGRAMME ANALYSIS

The closure of the Defence Force Base and the separation of the land tenure around Shelly Bay has resulted in a number of individual tenancies. These tenancies, as discussed within the context analysis, define the current programme and restrict hours of use.

These are considered as detrimental influences on the existing built environment, and therefore, present as issues that can be improved on through a designed building use for increased performance.

Informed by the realised precedents discussed in this chapter, this programme analysis explores how a designed programme can adapt an existing built environment to increase usability, building performance, and encourage the pro-environmental behaviour.

INFILL AND SUPPORT

In the 1970's, Vancouver's Granville Island underwent a triumphant revitalisation from a derelict maritime industrial sandbar as shown in Figure 3.01, into a bustling cultural hub shown in Figure 3.02 (Boddy, 2008). The success of the architects, Norman Hotson and Joost Bakker, was recognised to have come from their programmatic notion of 'infill and support' (Boddy, 2008).

The industrial workshops and existing brown-sites were adapted with minor alterations into a large variety of separate tenancies, and public spaces that supported one another (Tol, 2015). Without controlling visitors or functions, this demarcation allowed the Granville Island network to become self-sustaining by providing supply and demand to its own local economy.

This notion demonstrates an effective method of increasing building use through the employment of a circular programme, demonstrating a suitable approach for this design response.

FIGURE 3.01 // GRANVILLE ISLAND BEFORE DEVELOPMENT

FIGURE 3.02 // GRANVILLE ISLAND AFTER DEVELOPMENT

RESOURCE RECLAMATION

The Omega Centre for Sustainable Living, in Rhinebeck, New York, demonstrates the effectiveness of the Eco Machine™ water reclamation system. The system treats wastewater over several stages, utilising natural purification from; algae; fungi; bacteria; plants and snails, and can process up to 200,000L per day (Figure 3.03) (“Eco Machine™”, 2016).

The encasing building also demonstrates the highest rated standard of sustainable architecture and intends to inform peoples’ “knowledge of environmental sustainability, green energy, and regenerative design”, as expressed in Figure 3.04 (“Eco Machine™”, 2016).

This project successfully reclaims wastewater as a resource, while simultaneously educating through user experience (“Omega Centre for Sustainable Living”, 2009). This informs this design investigation by demonstrating that designed experiences can engage people’s knowledge and behaviour. Further, it provides valuable advice on how to design for resource reclamation of waste and storm water at a considerable volume.

FIGURE 3.03 // ECO MACHINE AERATED LAGOON

FIGURE 3.04 // OMEGA CENTRE FOR SUSTAINABLE LIVING

PASSIVE DESIGN

FIGURE 3.05 // CH2 DAY TIME PASSIVE STRATEGIES

FIGURE 3.06 // CH2 NIGHT TIME PASSIVE STRATEGIES

DesignInc, a Melbourne based architecture practice, designed the CH2 Melbourne City Council House 2 to 'rely on passive energy systems', and provide all occupants with fresh air, consistently ("CH2 Melbourne City Council House 2 | DesignInc", n.d.).

Passive design strategies utilise natural energy and processes to enhance internal environments, such as solar daylighting, thermal collection, and natural ventilation. The building design incorporates a variety of active and passive techniques, as shown in Figures 3.05, and 3.06 ("CH2 Melbourne City Council House 2 | DesignInc", n.d.).

These methods, although automated in CH2, can be applied to increase user knowledge and understanding of their built environment. By employing passive design strategies, the CH2 building provides opportunities for users to interact and have direct experiences of their possible influence on building management. This supports this design investigation in providing techniques for increasing building performance by educating and engaging building users to influence their own energy consumption and nurtures pro-environmental behaviours by developing knowledge and awareness.

DESIGN OPPORTUNITIES

The effective tools and strategies informed by these precedents include;

// Design for a self-sustaining programme that provides economic supply and demand by utilising the infill and support method

// Experiencing resource reclamation within the designed response as an effective technique of educating and increasing awareness

// Designed circulation can influence user productivity, efficiency, and building use.

// Passive design techniques can provide twofold benefits of increased building performance and economic use, in addition to providing opportunities for user interaction with building management.

LITERATURE REVIEWS

The collective buildings of the former Defence Force Base provide ample opportunities for adaptive reuse and sustainable development. Theoretical positions are discussed in this chapter to give an understanding of the topics and their application into architecture. These are investigated throughout three subsections;

// Building Reuse:

An investigation into the current state of deconstruction and adaptive reuse within the building industry

// Building Use:

An exploration into our current approach to building use

// Building User:

A discussion on the restrictions and opportunities presented by human behaviours and their influence on the built environment.

BUILDING REUSE: DECONSTRUCTION

Joe Ravetz is Co-Director of the Centre for Urban Resilience & Energy at the University of Manchester, and UK coordinator of the EU Network for Sustainable Urban & Regional Development.

In his 2008 paper, *'State of the Stock; what do we know about existing buildings and their future prospects?'* Ravetz identifies significant issues surrounding the reuse of existing buildings (4462). He exclaims *"existing and older buildings... often cannot cope with the increasing sophistication of engineering systems for heating, ventilation and air conditioning, telecommunications, security and surveillance"* (Ravetz, 2008, 4467). This issue encourages alternative building reuse, such as portion, component, or material reuse.

In listing a number of building information databases within the United Kingdom alone, Ravetz then identifies the varying and uncoordinated approach to building information management (2008, 4467).

This alludes to the difficulties in identifying areas of poor performance and restricts our abilities to discover and rectify problems. This indicates that a designed intervention should aim to increase knowledge and understanding of building management and information, in order to maintain awareness and the ability to resolve any arising performance issues.

The Research Centre for Building Performance, at Victoria University of Wellington in 2003, conducted a study on the existing state of deconstruction within New Zealand. Storey, Gjerde et. al detail;

"information received from demolition contractors suggests that newer buildings are more difficult to deconstruct than older buildings, due to the extensive use of multiple nailed joints, widespread use of glues, hidden fixings, and composite construction. Economic recovery of useful components in these circumstances is often very difficult." (2003, 97)

This is crucial in understanding how a designed intervention can challenge existing societal construction techniques. To architecturally design for eventual

deconstruction encourages typical construction to engage the idea of life-cycle, and of the value in reuse. This is a shift away from the current consumerist attitude of the designed environment toward biocentrism, which requires a consciousness of natural growth and energy cycles (Grzywa, 2015, 22). Experiencing this shift in attitude, and challenging typical construction practices will educate building users through the experience of the possibilities of deconstruction, and of the values of reuse.

Stephen John and Andrew Buchanan investigate the current techniques of treated timber disposal in their 2013 report “Review of End-of-life Options for Structural Timber Buildings in New Zealand and Australia” (5).

Their study posits that “the environmental impact of building materials extends well beyond their simple, useful, but relatively short life as components of a building” (John and Buchanan, 2013, 35).

Buchanan and John detail that “the behaviour of timber materials placed in landfills is complex and poorly understood” (2013, 5). Their report identifies that deconstruction and reuse are the most effective methods to maintain environmental neutrality over; landfilling; landfilling for later recovery; energy recovery; and chemical extraction (John and Buchanan, 2013, 20-21).

This theory supports this investigation by presenting evidence that the alternative practices to deconstruction and reuse, specifically in regard to treated timber within New Zealand, are environmentally harmful. This supports this thesis argument in that existing practices of design and deconstruction must be re-directed towards designing for deconstruction.

FIGURE 4.01 // [PAGE 50 + 51] EXISTING SHED SIX BUILDING CATALOGUE OF DE-CONSTRUCTED ELEMENTS

BUILDING USE: THE INFLUENCE OF OCCUPANTS

The Sustainable Energy Management and the Built Environment Project postulates theories in a special issue of Energy Policy, where through the editorial John Beddington explains:

“We consider how buildings might be constructed in the future and the drivers that will influence their development. New materials and methods ... and the forces that may encourage greener building practice are examined (Beddington, 2008, 4299)”

Beddington is the Chief Scientific Advisor to HM Government, and Head of the Government Office of Science, UK. His discussion ‘*Managing Energy in the Built Environment: Rethinking the System*’ summarizes several papers over several different categories which explain the current state of the built environment and identifies issues against, and possibilities for, a better future.

In summarizing the variety of expert reports, Beddington reveals that *“the soft barriers to progress are likely to be as important as hard ones such as the need to develop new technology”* (Beddington, 2008, 4300).

This posits that one of the fundamental challenges discovered by the scientific analysis is the ‘soft barriers’, such as the discarnate social sciences of building use. It reiterates that technological and material innovation alone is not enough to reinvigorate the existing built environment.

This thesis investigation intends to challenge existing user-participation in consideration of the behavioural effects on building performance. It aims to encourage and nurture user understanding of their behavioural impacts on their built environment.

Julie Kriegh is the 2014 recipient of the Upjohn Research Initiative Grant for her work in understanding how behaviour can drive building performance. Kriegh is the founding Director of Kriegh Architecture Studios and explains that you can design a sustainable ‘net zero’ building quite simply, but more consideration is required to design for the use and users (Richards, 2015, 37).

“It’s a matter of values that the client brings – altruistic, biospheric, or egoistic – and perceived value of benefit to cost. Behaviour is the wild card” (Richards, 2015, 37).

This further supports that behaviour and building use is a critically influential factor of building performance. Designing to engage specific behaviours within building users is recognised here as being more critical than designing for specific user groups. This thesis investigation builds on this argument by identifying specific behavioural patterns that encourage better building use and performance.

Kathryn B. Janda of Oxford University's Environmental Change Institute supports this argument in an issue of *Architectural Science Review*, 2011. The article titled '*Buildings don't use energy: people do*', is a detailed inquisition into how "*building users play a critical but poorly understood and often overlooked role in the built environment*", and of what needs to be done to rectify this (Figure 4.02, 4.03) (Janda, 2011, 15).

Janda's investigation reiterates that industry innovations, such as material and technological advancements, are "*necessary but not sufficient to achieve climate change mitigation targets*" (15).

This assists in developing both the scope of research and the design criteria for this thesis investigation. In supporting this thesis argument that sustainable buildings are sustainable objects without users, it reiterates that design investigations are required to consider the performance of the user over the performance of the building.

Her article demonstrates that the "*general population tends to treat buildings as static objects rather than dynamic systems*", and identifies that improving the energy performance of buildings requires "*changes in the entire fabric of society*" (Janda, 2011, 19). Having identified peoples' use of the existing built environment to be the fundamental issue requiring change, Janda suggests one solution that "*architects need to develop their professional expertise to improve buildings and seek ways of integrating user involvement in building performance*" (2011, 15).

This thesis investigation supports this argument and extends its exploration into how designed interventions can inform building users in a way that develops a behavioural shift.

FIGURE 4.02 // SINGLE OCCUPANT IN OFFICE USING 32 LIGHTS

FIGURE 4.03 // SINGLE OCCUPANT IN OFFICE USING 11 LIGHTS

BUILDING USER: PRO-ENVIRONMENTAL BEHAVIOUR

The literature reviews surrounding 'environmental psychology' are discussed to offer an understanding of the influential factors and identified barriers to a change towards pro-environmental behaviours.

In their article, '*Mind The Gap: why do people act environmentally and what are the barriers to pro-environmental behaviour?*', Agyeman and Kollmuss define pro-environmental behaviour as "*behaviour that consciously seeks to minimize the negative impact of one's actions on the natural and built world*" (2002, 240). Julian Agyeman, is a Professor of Environmental Policy and Planning at Tufts University, and Anja Kollmuss is a Tufts Climate Initiative Project Coordinator and policy analyst.

Their article summarises numerous theoretical frameworks, which explore the realised gap between the possession of environmental knowledge and awareness, and displaying pro-environmental behaviour (Kollmuss and Agyeman, 2002, 240). Their conclusion is not of one instigating factor but a complex network of influential factors that through normative, direct and indirect experiences inform peoples' environmental behaviour.

Their network model of factors, represented in Figure 4.04, has informed this thesis investigation by introducing a holistic model of influences and barriers, which presents as a well-considered framework for a designed intervention. This model also acts as a tool for critical analysis of a variety of case studies (discussed in chapter five) to determine their effectiveness in supporting pro-environmental behaviour.

In 1984, the increasing employment of sophisticated technologies was said to impede building performance as it removes the ability of a building user to interact and control their built environment (Kantrowitz, 26). In the thirty years since this proclamation, the technologies and our dependency on them has advanced, increasing the scale of this issue. Min Kantrowitz investigated "*Energy Efficient Buildings; An opportunity for user participation*", in her 1984 article for the Journal of Architectural Education (26). Kantrowitz, then president of Min Kantrowitz & Associates Inc., is nationally recognised across America for her research in applied energy and occupancy impact on building energy use. Kantrowitz describes two pre-existing theories.

Firstly, the theory of '*Environmental Competence*' explores a "*person's ability to negotiate and understand their environment in a meaningful way*" (Katrowitz, 1984, 28). Secondly, first posited in 1975, the theory of '*Learned Helplessness*' describes "*one's reactions in a situation in which one is unable to control a situation in which one is involved and which one cannot avoid*" (Kantrowitz 28). The correlation between these two theories is explained by Kantrowitz that;

"if one has learned to be helpless in the built environment because of lack of control, it is difficult to develop and maintain a sense of environmental competence, and through years of separating building users from the possibility of influencing their thermal and lighting environments, people have learned to be unable" (Kantrowitz, 1984, 28) .

This theory provides insight into how current anthropocentric design practices enable the aforementioned gap between having environmental knowledge and acting pro-environmentally. This informs this thesis investigation by identifying a significant behavioural influence, and suggesting that a designed intervention can overcome this gap by enabling building users to affect their building performance.

Ashley Grywza investigated the language used within 17 accredited design rating tools, such as Living Building Challenge; Green Star; BREEAM; and LEED. Grywza presented these findings in her thesis, '*Designing to Engage Users in Sustainable Buildings*' published in 2015 by the University of Maryland (2015, 3).

The analysis discovered that although the theme of 'user/operator accountability' was evident, it only accounted for 3% of total words used in the description and assessment method of the rating tools, which is expressed in the Figure 4.05 (Grywza, 2015, 28-29). This suggests the lessened significance placed on the building user within current practice of building use, and architectural design and discussion.

This loss of user significance is posited here as a predicament that needs to be resolved. It is the intention of this thesis investigation to increase awareness and significance of the building user through a carefully considered designed intervention.

FIGURE 4.04 // NETWORK OF BEHAVIOURAL INFLUENCES

FIGURE 4.05 // RATING SYSTEM LANGUAGE ANALYSIS - PERCENTAGE OF WORDS IDENTIFIED FOR EACH THEME

LITERATURE REFLECTION

The variety of theories posited around building reuse, building use, and user behaviours are informative in providing tested precedents for how this investigation can effectively respond to the aforementioned issues.

The research discussed by Ravetz in 2008, Storey, Gjerde et al., in 2003, and Buchanan and John in 2013, demonstrate that building reuse techniques are varying and suitability is to be determined in respect of each project.

The ideas suggested by Beddington in 2008, Richards in 2015, Janda in 2011, Kollmuss and Agyeman in 2002, and Kantrowitz in 1984, demonstrate the significance of restoring user interaction within the management of the built environment as a passive strategy of improving building performance.

Developing an understanding of how these issues and responses are challenged and applied within architectural interventions also presents as a critical tool for analysis of the selected case studies, and of the design response. The intention of this investigation is to create conversation around the tangible effects of building reuse and the discarnate behavioural effects of building occupants on the design response.

CASE STUDIES

This chapter discusses a variety of precedents that demonstrate the practices of adapting existing built environments, and engaging pro-environmental behaviours.

The literature reviews of the previous chapter informed the theoretical issues within this dissertation and posited appropriate responses to overcome them.

These precedents are specifically selected for their successful response to the described issues, and inform techniques of how architecture can build upon these theories.

The examples are critically reviewed for their abilities and restrictions in response to the objectives of this thesis investigation.

FIGURE 5.01 // REGEN VILLAGES

FIGURE 5.02 // [LEFT] VILLA WELPELOO

FIGURE 5.03 // [RIGHT] THE HIGH LINE PARK

REGEN VILLAGES

location: **Almere, The Netherlands**
designer: **EFFEKT**
date: **2016 – current**

Presented as a 'visionary model' for off-grid, integrated and resilient eco-communities, the ReGen Villages provide self-sufficient capabilities for all inhabitants (Figure 5.04) ("Regen Villages", 2015).

The design incorporates existing technologies for renewable energy and energy storage; high-yield organic food production; vertical farming; aquaponics; aeroponics; water management, and waste-to-resource systems into one integrated system (Figure 5.05) ("Regen Villages", 2015).

EKKEFT acknowledge that in addition to the obvious economic and environmental value, the ReGen Villages enhance social values and "*reconnect people with nature and consumption with production*", as seen in Figure 5.07 ("Regen Villages", 2015).

This quality is, critically, one that advances this thesis project's objective to increase awareness of and nurture pro-environmental behaviours.

The ReGen Village integrates household activities with the aforementioned technologies to reduce harmful environmental impacts. This integration passively and actively increases

FIGURE 5.04 // REGEN VILLAGES

user awareness of natural and localised processes for energy, food, water and waste through direct and indirect experiences.

This creates a consciousness of the influential ecologies, and with the integrated system throughout the village, it demonstrates the significance of collective consumption and production. This consciousness is the critical component in shifting societies from anthropocentric behaviour, to biocentric behaviour (Figure 5.06).

The EFFEKT ReGen Villages demonstrate that pro-environmental behaviour can be encouraged and practised without reducing qualities of life, simply by considering an alternative practice.

FIGURE 5.05 // [TOP] REGEN SYSTEM DESIGN

FIGURE 5.06 // [BOTTOM] DESIGNED BEHAVIOURAL SHIFT

FIGURE 5.07 // REGEN HOUSE INTERIOR

THE HIGH LINE PARK

location: **New York, NY, America**
designer: **James Corner Field
Operations & Diller
Scofidio + Renfro**
date: **2006 - 2014**

The High Line Park project is globally acclaimed for its success in adapting an existing industrial waste-land and engaging the public in an enhanced natural environment.

This designed integration of user with the natural and built environment makes this urban design a significant case study, as well as being an exemplary project in adaptive re-use.

The 2.4 kilometre elevated infrastructure serviced the western Manhattan area for close to 50 years before its decommission in the 1980's, and then remained unused until 2006 (James Corner Field Operations and Diller Scofidio + Renfro, 2015, 9).

Friends of the High Line, a preservation activist group, stalled the notion to demolish the structure, which initiated the development of the High Line Park revitalization project (James Corner Field Operations and Diller Scofidio + Renfro, 2015, 9).

In acknowledging the awe-inspiring natural growth throughout the existing site, planting designer Piet Oudolf explains the only appropriate design concept as “*creating an ambience that carried the essence of what was once there – that commemorated its attitude,*

FIGURE 5.08 // HIGH LINE THROUGHOUT THE SEASONS - WINTER SPRING SUMMER

FIGURE 5.09 // HIGH LINE PRE-DEVELOPMENT

its spirit" (Figure 5.09) (James Corner Field Operations and Diller Scofidio + Renfro, 2015, 193). This became a significant motion, for it enabled the park to educate and demonstrate to the public what their surrounding environment was capable of, thus creating a greater awareness of the natural processes as shown in Figure 5.11, and throughout the seasonal images of Figures 5.08, and 5.10.

Furthermore, the High Line Park demonstrated the potential of reuse not only for itself but extending to its surrounding environment and the wider industry. The variety of subsequent projects of this kind demonstrate a "*new global consciousness [of] the possibilities for sustainable reuse of underutilised and overlooked urban spaces*" (James Corner Field Operations and Diller Scofidio + Renfro, 2015, 194).

This advances the objectives of this thesis by demonstrating that the best practice for increasing building reuse within society is by physical application, enabling direct experiences and inviting consciousness to develop.

FIGURE 5.10 // HIGH LINE THROUGHOUT THE SEASONS - SUMMER AUTUMN WINTER

FIGURE 5.11 // HIGH LINE POST-DEVELOPMENT

VILLA WELPELOO

location: **Enschede, The Netherlands**
designer: **Architecten 2012 (then)**
Superuse Studios (now)
date: **2009**

The Superuse Studios are unique in their investigative research on material cycles, and in their designs for material reapplication.

Their perseverance and research into how to achieve compliance standards on reused materials is demonstrative of the challenges faced to overrun existing societal barriers surrounding recycling within the built environment.

Superuse Studios were said to “*short-circuit material flows by connecting demand with local supply*”, constructing 65% of the Villa Welpeloo from locally reclaimed materials (“Villa Welpeloo”, n.d.).

A discontinued textile factory was deconstructed and provided the steel structure of the Villa, while the timber slats that form the interior of a cable reel were collected and constructed as the Villa façade (“Superuse Studios”, 2015)(Figure 5.12, 5.15).

Throughout the interior fit-out, material re-use is prominent. Some examples of this can be seen in Figure 5.13, 5.14, and 5.15, with cabinetry and

FIGURE 5.12 // VILLA WELPELOO

furniture made from old billboards and lighting fixtures constructed from retired umbrellas (“Villa Welpeloo in the Netherlands Exemplifies ‘Recyclicity’”, 2012).

The Villa Welpeloo demonstrated an alternative design process by prioritising material research and availability. Superuse Studio’s exclaim “*the found materials resulted in new shapes and new ways of construction*”, in regard to the concept and design development of the project (“Villa Welpeloo”, 2009).

This approach advances the objective of challenging existing practices by exemplifying the relationship between material reuse and the design process.

It builds on the objective to innovate existing materials for adaptation by exploring waste materials as a resource, without restricting the material supply to have originated from the existing built environment.

FIGURE 5.13 // [TOP] UPCYCLED UMBRELLA LIGHT FITTINGS

FIGURE 5.14 // [LEFT] UPCYCLED BILLBOARD CABINETRY

FIGURE 5.15 // [MIDDLE] UPCYCLED BILLBOARD FURNITURE

FIGURE 5.16 // [RIGHT] VILLA FACADE DETAIL

CASE STUDIES REFLECTION

These case studies evidence design methods and techniques for adaptive reuse and enabling pro-environmental behaviour within the built environment.

Their success supports features of the following design criteria, which forms a robust framework for the development of the designed response.

DESIGN CRITERIA

The preceding chapters assess context, programme, and critically analyse and reflect on relevant literature and precedent case studies which inform the following set of design criteria:

BUILDING REUSE

- Adaptation of the existing built environment should assess suitability for whole building reuse, or other techniques such as material reuse, or building component reuse.
- Designs for the proposed intervention should consider, in detail, the ease of component separation to ensure economic deconstruction and reuse in future.

BUILDING USE

- The proposal should create interventions that highlight and create awareness of our building use, and create opportunities to educate and demonstrate a desired building use and performance.
- The designed response should increase the building performance, comparative to the existing built environment, which ought to be achieved through a carefully considered and designed use.

BUILDING USER

- The intervention should create experiences that may inform and alter user behaviour, within all built environments, toward more energy efficient practices of building management.
- To challenge normative anthropocentric behaviours, the design response shall highlight the integration of biocentrism to demonstrate an alternative behaviour.

TWO

PRELIMINARY DESIGN

This chapter demonstrates the process undertaken in researching through design, the question, aims, and objectives of this investigation.

Concepts and ideas suggested throughout the literature reviews, case studies, and programme analysis are tested throughout this process which is presented under three headings; preliminary experiments; preliminary concepts; and preliminary design.

Preliminary experiments portray the initial investigation into understanding the detrimental influences on the existing built environment.

The preliminary concepts and design portray the designed response to adapting the existing environment to increase usability and performance, and to challenge existing unsustainable societal practices.

PRELIMINARY EXPERIMENTS

Site Analysis

This task was undertaken to survey and document existing qualities of the site that are considered to perform unsustainably.

The analysis identified that several areas influenced the existing poor performance of the site, including issues of accessibility, connectivity, tenure, maintenance, programme and use, and a lack of opportunity to interact with the natural environment (Figure 7.01, 7.02). These issues were used to inform a series of design principles;

/ a shift in focus toward pedestrian use

/ increased accessibility to the surrounding suburbs and amenities, the wider city, and civic networks such as the train station, harbour ferries, highways, and the airport.

/ programs should increase daily life, providing a variety of uses throughout all times of the day and night

/ programs should sustain the localised 'infill and support' notion

/ developed integration with the water's edge

/ a variety of environments should be provided (parks, function centres, gardens, eateries)

/ 'natural environments' should be accessible and informative as to their use, production, and benefits.

These principles were then tested as design strategies throughout the preliminary concepts with intentions to mitigate detrimental influences.

FIGURE 7.01 // SITE ANALYSIS SKETCH PLAN AT 1:5000 SCALE

FIGURE 7.02 // SITE ANALYSIS SKETCH PLAN AT 1:2500 SCALE

1839

J. Crawford purchases peninsula and wider area from The New Zealand Company and calls it Miramar.

1885

Crawford sells peninsula for Military Defence purposes.

1907

Transferred to The New Zealand Navy

Reclamation work begins
in Shelly Bay.

1942 1946

Transferred to the

New Zealand Air Force

Closed as
Air Force Base

Government sold reclaimed land
owned by NCC.

1995

2002

2008

Port Nicholson Family Trust
bought 8049m² land as
part of Treaty of Waitangi
Settlement deal.

PRELIMINARY CONCEPTS

Pedestrian Focus

To create a shift in focus towards pedestrian use and scale, areas of the existing built environment are proposed as shared, with the former predominance on vehicles removed (Figure 7.03).

Areas of the natural environment are developed with a pedestrian scale, to create more opportunities for public use and interaction (Figure 7.03 - 7.05).

FIGURE 7.03 // PEDESTRIAN SHARED ACCESS

FIGURE 7.04 // PEDESTRIAN TERRACED LANDSCAPE

FIGURE 7.05 // [P.96 + 97] VARYING SCALES OF PEDESTRIAN INTERACTION WITH ENVIRONMENT

observation - over

submersion

on - under

interaction , -Through

Integration with the Natural Environment

To increase the opportunities for engagement with the environment, and in ways that educate and encourage consideration of biocentrism, a variety of environments should be provided (Figure 7.08).

These concepts look at providing instances for the public to experience the benefits and processes of sustainable features incorporated across the site and integrated within the existing buildings, such as on-site rain and stormwater collection and treatment (Figure 7.06, 7.07).

FIGURE 7.06 // RAINWATER AND STORMWATER FILTRATION

FIGURE 7.07 // [ABOVE] GREEN WALLS AND ROOFS INTEGRATED INTO EXISTING BUILDING
FIGURE 7.08 // [RIGHT] 'PICK-A-PARK' VARIETY OF NATURAL ENVIRONMENTS

City Connections

Strategies considered to increase the connections to the surrounding suburbs, city, and civic networks such as the train station, airport, and harbour ferries were tested to ensure accessibility to the site.

This proposal included retrofitting the former Shed Eight building into a transport hub, for connecting vehicles from the harbour, and road, and an energy efficient tram from the airport. A bike-share system is investigated to increase accessibility around the site and to the wider city. (Figure 7.09, 7.10).

*FIGURE 7.09 // [ABOVE] BIKE SHARE STATION
FIGURE 7.10 // [BELOW] TRAMWAY BETWEEN HIGHWAY AND SHELLY BAY*

Programme

Proposing an adapted programme mitigated a number of detrimental issues as it had potential to increase daily life around the site, increase public use and support the demand for connectivity and accessibility (Figure 7.11).

A circular programme was designed to provide self-sufficient support and demand, generating a circular economy on site (Figure 7.12).

Once the programme was designed, the existing building stock was scheduled and assessed on its suitability for adaptation (Figure 7.13).

FIGURE 7.11 // [RIGHT] PROPOSED PROGRAMME AND SITE POSITIONING

FIGURE 7.12 // [P. 106] CIRCULAR PROGRAMME MAP

FIGURE 7.13 // [P.107] ADAPTATION SUITABILITY ANALYSIS

proposed programs // INFILL AND SUPPORT PROGRAM MAP

▲ support direction

● day

● evening

● night

long and narrow

ideal building shape for natural light into rooms
 ideal for green roof as roof shape and drainage not complicated
 ideal for earth insulation as shallow depth allows natural light to fill room from glazing on one side ideal for multiple rooms and/or tenancies

short and square

ideal building shape for natural light into rooms
 ideal for green roof as roof shape and drainage not complicated
 ideal for earth insulation as shallow depth allows natural light to fill room from glazing on one side ideal for multiple rooms and/or tenancies

combination

ideal for core services, structure, or
 ideal for smaller and/or single tenancies

workshop

skylights ideal for natural lighting above large floor area
 large tenancy or smaller tenancies suitable

Master Plan

Collectively, the preliminary concepts have varying scales of intervention within the existing natural and built environment. The master plan expresses the preliminary concepts of pedestrian focus, integration with the environment, connectivity and programme within one cohesive proposal, shown in Figure 7.14.

This strength of this master plan is the integration of all the preliminary concepts, which were designed to mitigate the issues identified throughout the site analysis. Due to the urban scale of the scheme, three refined areas were suggested for architectural development, which were discussed in the critical review.

FIGURE 7.14 // [P. 110 + 111] MASTERPLAN CONCEPT

Concept Reflections

These preliminary concepts and their integrated proposal as a master plan show possibilities for success in site reinvigoration. However, they also have the potential to overlook the areas of detail design, technical and logistical restrictions, and other possibilities that are inherent to building reuse.

The scales of these concept interventions are considered to be minimally intrusive, which might result in minor changes in building performance and use in comparison to a very intrusive intervention. To focus on the existing built forms instead of the site provides more opportunities to challenge and discover how building reuse can achieve the aims and objectives of this investigation.

Following a formal critique, and critical reflection, this proposition begins to focus on one architectural intervention, allowing more discussion and translation between the case studies, and literature opinions on the topic of building reuse, and pro-environmental behaviour.

PRELIMINARY DESIGN

Material Reuse

The Shed Eight workshop building was measured and scheduled to create a catalogue of existing building elements, or materials that were suitable for reuse (Figure 7.15 – 7.18).

This informed the proposal by providing a technical framework for dimensions, scale, and material palette, all of which are considered as both a challenge and opportunity unique to the reuse of this particular building.

FIGURE 7.15 // [P.115] SKETCHES RECORDED AT SHED EIGHT SITE MEASURE
FIGURE 7.16 // [P. 115] PHOTOGRAPHS SHOWING THE EXISTING SHED EIGHT BUILDING
FIGURE 7.17 // [P. 116] DIGITAL MODEL OF EXISTING SHED EIGHT BUILDING
FIGURE 7.18 // [P. 117] EXPLODED DIGITAL MODEL OF EXISTING SHED EIGHT BUILDING

Plan and Form Iterations

The proposal considered the existing building within plan and form iterations by keeping expressions of its former construction, such as the sawtooth roof shape, or the site position (Figure 7.19 - 7.21).

FIGURE 7.19 // PLAN AND FORM ITERATION SKETCHES

PLAN

FORM

FIGURE 7.20 // [P.121 TOP] PLAN AND FORM ITERATIONS OF CIRCULAR SAW TOOTH ROOF

FIGURE 7.21 // [P.120 + 121 BOTTOM] PLAN AND FORM, AND SECTIONAL ITERATIONS OF SAW TOOTH ROOF

The plan iterations developed to be informed by, and incorporate, the proposed programme which was designed in the preliminary concept phase and reconsidered here within the architectural response (Figure 7.22, 7.23).

FIGURE 7.22 // PLAN AND FORM ITERATIONS DEVELOPING IN CONSIDERATION OF PROGRAMME

FIGURE 7.23 // PLAN AND FORM ITERATIONS DEVELOPING WITH FOCUS ON PROGRAMME

Programme and Form Development

The plan, programme, and form iterations further developed from the dimensions of the former building, which was considered critical in maintaining the original proportions, and for application of existing structural elements (Figure 7.24 - 7.27).

FIGURE 7.24 // FORMER BUILDING DIMENSIONS AND PLAN ITERATIONS

FIGURE 7.26 // FORM DEVELOPMENT

PLAN

ELEVATION

PERSPECTIVE

FIGURE 7.27 // DEVELOPED FORM AND MATERIAL ITERATIONS

The proposed form was modelled to test and explore its position on site. These photographs show the site and building model, which was made entirely from waste materials (Figure 7.28).

FIGURE 7.28 // [P134 - 137] PHOTOGRAPHS SHOWING WASTE MATERIAL SITE AND FORM MODEL

The preliminary design iterations were refined and presented for critique to invite discussion surrounding the investigation approach and concept development (Figure 7.29 - 7.33)

FIGURE 7.29 // [RIGHT] PROJECT VISUALISATION FROM HARBOUR

FIGURE 7.30 // [P.136] VISUALISATION SHOWING APPROACH FROM SOUTH

FIGURE 7.31 // PRELIMINARY DESIGN GROUND FLOOR PLAN

BUSINESS // Level One

HOTEL // Level Two

HOTEL // Level One & Three

FIGURE 7.32 // PRELIMINARY DESIGN UPPER FLOORS PLAN

FIGURE 7.34 // [P. 142] VISUALISATION FROM MAIN ENTRY INTO GREEN HOUSE ATRIUM
FIGURE 7.33 // [P.143] VISUALISATION SHOWING SECTIONAL VIEW OF PROPOSAL

PRELIMINARY DESIGN REFLECTIONS

The design developments evidence the successful incorporation of the preliminary concepts of building reuse, self-sufficient programme design and integration with the natural environment into one architectural intervention.

The process of developing form, and then plan, as alternative iterations demonstrated a robust research method of investigating the design aims and objectives, such as discovering opportunities and restrictions of building reuse, and integration with the site.

Following a formal critique of this design, the critical reflection and discussion suggested this project was successful in realizing the design intent and should focus on the detailed development that would provide conviction for the varying aspects of the designed response.

DESIGN RESPONSE

This design response presents as one example of an adaptive reuse project within an existing built environment that challenges occupant behaviour to improve building use and performance.

Design strategies used to overcome issues of building reuse, and to effectively influence occupant behaviours have been presented throughout the case studies, literature reviews, and programme analysis and are incorporated within this designed intervention.

The proposal incorporates the following strategies for resource reuse, adaptation, and to increase user interaction to mitigate issues of waste and unsustainable behaviour within the built environment.

FIGURE 8.01 // VIEW OF PROPOSED SHED EIGHT BUILDING FROM ABOVE

BUILDING REUSE

Resource Reuse Strategies

This proposal incorporates material reuse of elements catalogued from a hypothetical deconstruction of the existing building (Figure 8.02 - 8.03).

Material reuse was an effective reuse strategy informed by the Villa Welpeloo precedent, however, this design utilises existing materials from an otherwise semi-derelict building. This is to mitigate issues of construction and demolition waste, and issues surrounding unused existing building stock in one integrated proposal (Figure 8.04).

FIGURE 8.02 // EXISTING SHED EIGHT BUILDING SHOWN IN DIGITAL MODEL AND EXPLODED MODEL

FIGURE 8.03 // CATALOGUE OF EXISTING MATERIALS

FIGURE 8.04 // EXPLODED DIAGRAM SHOWING PROPOSED MATERIAL REUSE STRATEGY

PROPOSED BUILDING

Over 90 percent of the catalogued materials have been adapted for reuse in this proposal, with a provision for loss in the change process.

These proposed adaptations are expressed in Figure 8.04, and 8.05, and are calculated from linear meterage of the existing and proposed members.

WEATHERBOARDS

STUDS

LARGE COLUMNS + ROOF TRUSS FRAMING

SMALL COLUMNS

ROOF FRAMING

ROOF TRUSS FRAMING

ROOF TRUSS FRAMING

FIGURE 8.05 // INFOGRAPHIC OF QUANTIFIED MATERIAL REUSE

The conviction of this material reuse strategy is within the detailed design, which develops awareness on the possibilities of reuse, and challenges existing consumerism practices by detailing for deconstruction and further reuse (Figure 8.06).

This detailed design was informed by the literature theories of Andrew and Buchanan, and Storey, Gjerde et al, which considers the poor end of life options for timber elements, and the current practice issues preventing deconstruction and reuse.

PROPOSED COLUMN ISOMETRIC DETAIL
NTS

FIGURE 8.06 // DETAIL DESIGN OF COLUMN REUSE

FIGURE 8.07 // [P.159] VISUALISATION OF COLUMN REUSE IN PROPOSAL

PROPOSED COLUMN PLAN DETAIL
SCALE 1: 10

Elements that are reused structurally are proposed to have undertaken engineer testing and approval before their designed application (Figure 8.07).

A large portion of the existing materials are used in a non-structural application, such as attached louvres for solar control, or floor coverings (Figure 8.08 - 8.11).

FIGURE 8.08 // DETAIL DESIGN OF WALL STUD REUSE

FIGURE 8.09 // [P.161] VISUALISATION OF WALL STUD REUSE AS LOUVRES IN PROPOSAL

FIGURE 8.10 // DETAIL DESIGN OF WEATHERBOARD REUSE

FIGURE 8.11 // [P.163] VISUALISATION OF WEATHERBOARD REUSE AS FLOORING IN PROPOSAL

BUILDING USE

Adaptation Strategies

The preliminary programme design was refined into a self-sufficient circular model that features five key functions which supply a demand and support for one another with clientele, and resources, such as energy, produce, and water (Figure 8.12).

FIGURE 8.12 // PROPOSED CIRCULAR PROGRAMME

The five programmatic functions are described within three programme areas of; Business; Amenities; and Hotel (Figure 8.13).

The three areas are positioned independently throughout the building, but their strength is that they have considerable overlaps and function as one corporation.

FIGURE 8.13 // DIAGRAM SHOWING THREE PROGRAMME AREAS

BUSINESS PROGRAMME

AMENITIES PROGRAMME

The following plans and section show the designed programme on the ground, and upper floors of the proposal (Figure 8.14 – 8.18).

FIGURE 8.14 // PROPOSED SITE PLAN

0 5 10 20 50 100

FIGURE 8.15 // PROPOSED GROUND FLOOR PLAN

GROUND FLOOR
Scale : NTS

UPPER FLOORS
Scale : NTS

Direction of Timber Flooring
Staff + Service Circulation

Void
Main Pedestrian Flows

There are six main entrances into the building, and multiple secondary entrances or exits (Figure 8.15).

The programme was designed with a priority on the circulation of both guests, and services to maximize efficiencies for use. This circulation is also designed within the fabric of the construction, creating intuitive orientation and encouraging user exploration (Figure 8.16).

FIGURE 8.16 // PLAN DIAGRAM SHOWING CIRCULATION

FIGURE 8.17 // PROPOSED UPPER LEVELS FLOOR PLAN
FIGURE 8.18 // NORTH-SOUTH CROSS SECTION

Informed by the Granville Island, Regen Village and Omega Centre precedents, the adapted programme of the shed eight building incorporates strategies to increase daily life, to create a self-sufficient economy and to integrate sustainable systems.

This proposal evidences that these strategies can be designed in consideration of one another to generate an adaptive reuse that enables users to interact with their built environment.

The following images (Figure 8.19 - 8.25) show the three areas and programmatic features of this designed response.

FIGURE 8.19 // APPROACH FROM THE SOUTH SHOWING HOTEL, THEN AMENITIES AND BUSINESS PROGRAMME

FIGURE 8.20 // AMENITIES PROGRAMME MAIN ENTRANCE INTO GREENHOUSE INTERIOR

FIGURE 8.21 // AMENITIES GUEST KITCHEN AND LOUNGE

FIGURE 8.22 // HOTEL PROGRAMME APPROACH AND HOTEL ENTRANCE

FIGURE 8.23 // WEST HOTEL ROOM ON MIDDLE FLOOR

FIGURE 8.24 // BUSINESS PROGRAMME ENTRY AND MARKET STORE ENTRY

FIGURE 8.25 // OPEN PLAN OFFICE INTERIOR ON UPPER FLOOR

BUILDING USER

Passive Design Strategies

The theories posited by Janda, Kantrowitz and Grwyza evidence that the most effective strategies to engage building users is to design for their interaction. To enable their control and management provides an opportunity for users to increase their understanding of their influence on the built environment.

Passive design strategies mitigate the buildings energy consumption by lessening the dependence on mechanical lighting, ventilation, and equipment use (Figure 8.26 - 8.28).

This strategy is successful in both providing opportunities for user management, and also for efficient energy consumption.

The integration of this strategy would likely require brief demonstrations or instructions from building personnel as some features might not be intuitive.

FIGURE 8.26 // [P.193] PASSIVE DESIGN DAYLIGHTING STRATEGIES DIAGRAM

FIGURE 8.27 // [P.194] PASSIVE DESIGN VENTILATION STRATEGIES DIAGRAM

FIGURE 8.28 // [P.195] PASSIVE DESIGN EQUIPMENT STRATEGIES DIAGRAM

sun

daylighting maximised as light source
 light wells + atrium for daylight deep in plan
 sun shading adjustable louvres - user operated
 with mechanical override as backup

example of user opportunity

light switches that encourage increasing
 or decreasing the amount of natural daylight
 by adjusting the angle of external louvre

ventilation

natural stack ventilation - user operated
 internal windows into atriums + light wells - user operated
 fresh cooled air fed at low speeds through floor vents - user operated
 evaporative cooling across oxygenated lagoon + wetlands + harbour

example of user opportunity

an interactive monitor to control interior climate
 with options for private control and automated control
 and openable windows strategically high and
 low to encourage natural stack ventilation

equipment

photovoltaic array generating 48kW for building use + surplus as income
 solar hot water panels to heat 3000L in summer, and 1650L in winter
 roof windows to open mechanically for heat purge

example of user opportunity

electrical energy use wall display unit
 allowing occupants to self monitor their
 consumption relative to the buildings generation

User Interaction Strategies

Informed by the Omega Centre precedent, this strategy integrates the Eco Machine System for water recirculation which educates visitors on their water use and its possible reuse.

The six-phase system is an integral part of the design response and an essential component of the designed programme (Figure 8.29).

The water filtration achieved by the Eco Machine purifies the water so that it can be redistributed throughout the community gardens, providing some produce for the hospitality programme.

This feature closes the self-sufficient loop, giving the design response a unified quality across the collective programmatic functions.

FIGURE 8.29 // WATER RECIRCULATION PROCESS DIAGRAM NUMBERED 1 - 6.

1. rain water collection
rainwater is collected, filtered, and
reused throughout the building

2. grey + waste water
grey + waste water collected,
solid waste pumped out

3. equalisation tanks
waste water pumped into two
equalisation tanks, which equalise
over 24 hours

4. anoxic tanks
water flows into two underground
tanks ammonia, phosphorus,
nitrogen, and potassium
are digested by organisms

5. wetlands
flow is gravity fed evenly throughout
constructed wetlands

6. aerated lagoon and terraced gardens
flow is pumped inside to highly oxygenated
lagoons, then the purified water is distributed
throughout the terraced vegetable gardens

DESIGN RESPONSE REFLECTIONS

The strength of this design response is realised within the development of the details, which give conviction of the intent and integrate the varying programmatic functions into one integrated proposal.

Strategies for material reuse, adaptation, and enabling a more sustainable user behaviour are informed by precedents, introduced throughout the preliminary design, and then improved on within this chapter.

The applied strategy for material reuse was improved on by sourcing materials from the original construction, mitigating issues of construction and demolition waste, deteriorating building stock, and unsustainable resource extraction.

The applied strategies for adaptation and to challenge user behaviour were improved on by integrating a variety of sustainable systems. These were essential in realising a self-sufficient programme and provide a variety of opportunities to educate users for an increased building use and performance, mitigating issues of learned helplessness.

These improvements are in response to the identified issues, and design criteria, making them unique to this project, however, the process for which they have been applied and developed on can be applicable to any project.

This design response evidences an adaptive reuse project within the existing built environment which encourages selective occupant behaviour to improve building use and performance. The response succeeds in designing passive and energy efficient strategies, however, it does not yet compel users to engage in personal energy performance monitoring. This suggests that performance monitoring strategies, such as digital watches providing comparative feedback, or visual screens to display energy consumption by area are needed in addition to design.

CRITICAL REFLECTION

The built environment has a 30% take of global energy consumption, which is in part generated from un-renewable sources and is therefore unsustainable (IEA and IPEEC, 2015, 17). The current approach to this issue is observed throughout energy mitigation targets, policies and rating tools that typically address new construction and aim for greater energy efficiency (Beddington 2008, 4299). Analysis of the existing building stock shows that only 1-3% of buildings are renewed each year, and indicates that up to 75% remain as existing (Ravetz 2008, 4462). At this rate of renewal, most energy mitigation targets of this generation will not be met unless the energy consumption of the existing building stock is addressed.

Architecture is one of few disciplines with the potential to influence both the energy use of new and existing buildings and to increase the reusability of existing constructions through design. This investigation explored the constraints and opportunities of building reuse and designed experiences that could influence occupant behaviour in regard to their energy use and their understanding of environmental cycles. This research evidences that design can mitigate the aforementioned issues by designing for occupants to have less dependency on energy within buildings, and to demonstrate the significance of building reuse, and encourage designing for deconstruction. This research found limitations in the ability of architecture to resolve the aforementioned issues in their entirety. The design strategies used are determined to not be enough to influence energy use of occupants, as they do not provide monitoring or feedback abilities.

This investigation extended into areas of environmental psychology to determine the best possible means to engage selective behaviours among building occupants. The research discovered that the most effective way for architecture to encourage energy-efficient occupant behaviour was simply to provide opportunities for users to engage, understand, and interact with their built environment. This conclusion warrants the applicability of this design process within other existing built environments, as it is dependent on the built envelope rather than site-wide or external influences. A limitation of this approach, as mentioned above, is that there are no tangible incentives or feedback, suggesting that although occupants learn techniques to use buildings in a more energy efficient way, they are not able to learn how effective their efforts are. Furthermore, this proposal details an energy-efficient design that utilises existing materials, however, the key focus on challenging behaviour is realised by providing opportunities. In reflection, this is critically considered as needing further improvements in order to compel sustainable behaviour, rather than simply provide opportunities for it.

Other limitations of this proposal are within the economy of the building industry, which supports demolition over deconstruction and reuse (Storey, Gjerde et al. 2003, 96-98). This contributes to construction and demolition waste and encourages a consumerist behaviour

within design and specifications. This research discovered that an increasing dependency on component construction and material innovations are further restricting the feasibility of deconstruction and reuse because the materials are unable to be dismantled or separated. Architecture has the potential to design for deconstruction, by instructing construction methods that are reversible, and specifying materials that are separable, making reuse more economically feasible in future.

This project explored material reuse over building re-use as the existing building envelope was considered unsuitable for an adapted programme. The discovered limitations of material reuse were the lack of information on existing materials, in addition to some materials containing harmful substances or being in a state of disrepair.

This research provides a solution to issues within the existing building stock, and within energy consumption of building occupants, however, these findings are constrained by their lack of response to any current demands within the property or financial market. Demolishing the existing building would be more economical than this proposal, but would not address or support any behavioural shift towards biocentrism or energy efficiency within the built environment, nor mitigate any of the identified issues.

This thesis presents one example project set within a larger contextual argument. The investigation followed a very linear process, where the research informed strategies for the design, which was continued throughout preliminary, concept, and developed design phases up to the design response. The outlined methodology could be applied to any existing built environment, to achieve the design aims and objectives of the theoretical argument. Furthermore, the research findings on effective techniques to design for energy-efficient occupant behaviour are not restricted to adaptation projects and should be integrated into new designs.

The scope of this proposal was refined to one architectural intervention at an early stage of development. To advance the investigation, this proposal would extend to the remaining thirty buildings of the former defence force base. This designed response could provide some infrastructure and support for the revitalization of other buildings at the site, as they have the same or similar influences on the initial behaviour and energy consumption, and therefore would require the same or similar design strategies. To advance the argument, the investigation would extend into the property and financial markets, to generate discussions and a greater focus on realistic feasibility. To critique architecture, this discussion pushes for a greater engagement of architects in responding to the issues presented in this thesis. Architects need to integrate users within designing for building performance and cooperate with other professions to succeed in areas beyond the limitations of architecture.

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LIST OF FIGURES

Unattributed figures are created by, or belong to the author.

Figure 1.02 // Existing Built Environment of Wellington City

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Figure 1.03 // Encouraging Pro-Environmental Behaviour

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Figure 2.02 // Overlooking Shelly Bay Air Force Base, 1948

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Figure 3.01 // Granville Island Before Development

Munro, R. (1950). Aerial view of Granville Island, looking north with Burrard Bridge, Kitsilano Trestle Bridge and "old" Granville Street Bridge. City of Vancouver Archives 541d2812-5ac2-495c-9633-5409cac09254-A75390.jpg. Vancouver, CA.

Figure 3.02 // Granville Island After Development

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Figure 3.03 // Eco-Machine Aerated Lagoon

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Figure 3.04 // Omega Centre for Sustainable Living

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Figure 3.05 // CH2 Day Time Passive Strategies

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Figure 3.06 // CH2 Night Time Passive Strategies

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Figure 4.05 // Rating System Language Analysis - Percentage of words identified for each theme

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