



# AdAPTA Home

R.M.W









# AdAPTA Home

By Renée Michelle Williamson

A 120 point thesis submitted to the School of Architecture and Design, Victoria University of Wellington, in partial fulfilment of the requirements for the degree of Masters of Architecture (Prof.)

Victoria University of Wellington:

2017



#### NEW ZEALAND

Urban form and how it relates to the landscape  
The urban form is a result of the landscape  
The urban form is a result of the landscape  
The urban form is a result of the landscape



#### MALAYSIA

Urban form and how it relates to the landscape  
The urban form is a result of the landscape  
The urban form is a result of the landscape  
The urban form is a result of the landscape

## ACKNOWLEDGEMENTS

Firstly I would like to thank my fantastic supervisor Shenuka De-Sylva, who has guided me through my thesis. I am forever grateful for the invaluable knowledge you have shared.

Thank you to Victoria University for the services and amenities available to me over the last five years of study, which have helped me to gain my degrees. I would also like to thank the staff and tutors, without whose support I would not have gained the knowledge I now have.

Thank you to my parents, Jim, and all my family and friends who have encouraged me throughout my life to follow my dreams and never give up.

And most importantly, thank you to God for giving me the enduring passion for architecture.



*"As we live and as we are, Simplicity - with a capital "S" - is difficult to comprehend nowadays. We are no longer truly simple. We no longer live in simple terms or places. Life is a more complex struggle now. It is now valiant to be simple: a courageous thing to even want to be simple. It is a spiritual thing to comprehend what simplicity means."*

*- Frank Lloyd Wright*



## ABSTRACT

The current housing situation in New Zealand has pushed young New Zealander's out of home ownership. A national shortage of housing stock, high house and land prices, off-shore investors, high student loans and the fact that incomes have not risen as rapidly as house prices has contributed to this situation. Young New Zealander's are increasingly spending prolonged amounts of time flatting, renting or living with family in order to have the fundamental requirement of a roof over their head and to save money.

The intention of this research is to establish a design outcome that provides an affordable and adaptable housing option for young New Zealander's seeking home ownership. The outcome is informed by various examples of refined and affordable housing, the relationship between user and architecture, and the testing of what is truly necessary for a functional home.

The proposed solution is the 10m<sup>2</sup> "AdAPTA Home"; a refined and mobile housing model free of excesses and yet functional and adaptable to user needs. The design looks at how much space is truly necessary in our homes for living, and how much can be removed. The design is intended to be used throughout one's life; beginning as an affordable initial housing option for a young person to achieve full home ownership in a short time frame, before moving through various stages in life where the dwelling can grow and adapt in response to changing needs, various situations and environments.

*Figure 04. (Opposite) Author's own artwork, "Escaping to a place of retreat and refuge, away from the formalities of everyday living".*





A WISE MAN BUILT HIS HOUSE ON THE ROCK.  
A FOOLISH MAN BUILT HIS HOUSE ON SAND.

# Contents

**VII        ACKNOWLEDGEMENTS**

**XI        ABSTRACT**

## CHAPTER ONE

**01        INTRODUCTION**

03        The Problem

06        The Proposition

**08        AIMS & OBJECTIVES**

**09        SCOPE**

## CHAPTER TWO

**15        LITERATURE REVIEW & CASE STUDIES**

**17        LITERATURE**

19        Opening Statement

20        Fundamental Human Needs

21        The New Zealand Bach

22        Refining Space

24        Ergonomics & Proportion

28        Key Findings

**31        CASE STUDIES**

32        Hut on Sleds

34        One sqm House

36        Microhotel

38        Keret House

40        Kenchikukagu Foldable Rooms

42        Mobile M-House

44        Key Findings

## CHAPTER THREE

**47        DESIGN CONSIDERATIONS**

48        The 10m<sup>2</sup> House

50        The 1m<sup>2</sup>

57        Core Spaces of Use

	<b>CHAPTER FOUR</b>
<b>61</b>	<b>DESIGN CONCEPTS &amp; PROCESS</b>
62	Kitchen Concept
64	Bathroom Concept
66	Combined Bedroom & Living Concept
68	Configurations for Bathroom & Kitchen
<b>70</b>	<b>EXPLORING FORM</b>
75	Exploring Materiality
78	Exploring Structure
80	Intended Method of Use
	<b>CHAPTER FIVE</b>
<b>85</b>	<b>FINAL DESIGN</b>
86	Final Design Proposal
94	Kitchen Cube
96	Bathroom
98	Bedroom & Living
103	Cost & Component Breakdown
106	Construction
112	Services
116	Multiplication
	<b>CHAPTER SIX</b>
<b>125</b>	<b>APPLICATION &amp; LOGISTICS</b>
	<b>CHAPTER SEVEN</b>
<b>133</b>	<b>CONCLUSION</b>
<b>143</b>	<b>BIBLIOGRAPHY &amp; LIST OF FIGURES</b>

Q.

*How might a domestic living space become an affordable and flexible home that grows with its users, and adapts to diverse situations and environments?*











# CHAPTER ONE

## INTRODUCTION



## The Problem

New Zealand's house prices are rising rapidly across the country, mainly due to a high local demand triggered by a growing population, shortage of housing stock, increasing land and construction costs, and off shore investors. Home ownership is unattainable for most young New Zealander's or first home buyers, due to the above reasons, high student loans and the fact that household incomes have not risen as rapidly as house prices (Watkins and Fyers). This has resulted in a generation of renters.

Since 2008, the amount of home renters has risen by 18% to 593,000 people, and homeownership rates have dropped by 3%, both the highest percentages seen since 1991 (Twyford). In a poll of 2000 people, almost 60% of non-homeowners stated that owning their own property is not an achievable goal within the next five years (Satherley). When these non-homeowners were asked how they might achieve property ownership, they stated:

- Half expect to take money from their KiwiSaver.
- One quarter expect to work more hours.
- 19% will seek more affordable options elsewhere.
- 18% will look to their families for assistance.
- 11% hope to use an inheritance.
- 1 in 10 will purchase with family.
- Almost 1 in 5 will not attempt home ownership (Satherley).

According to Craig Herbison of the Bank of New Zealand, renters are twice as likely to live from pay cheque to pay cheque than home owners, where one-in-three renters say they spend more than they earn, making saving for a deposit unlikely (Satherley). Not only is homeownership increasingly unattainable, it has also been associated with one's optimism:

*"We asked if it was the right time for people to buy their first home; 63 percent of property owners think it is a good time, versus only 37 percent of non-property owners" (Satherley).*

Another factor adding to the number of non-homeowners is the level of unemployment in New Zealand. Contribution to this is the high numbers of youth not gaining sufficient school education and not embarking on tertiary education or training, or not graduating from their tertiary education or training institutions.

#### Unemployment:

According to Statistics NZ, the unemployment rate for 15-24 year olds is 15%, more than double the overall rate of 5.8% (Enoka). It is interesting to note that compared to other ethnicities, young Maori and Pacific Islanders tend to have higher rates of unemployment, with a NEET rate (not in employment, education or training), of almost 20%, compared to 9.5% for Europeans and 7% for Asian.

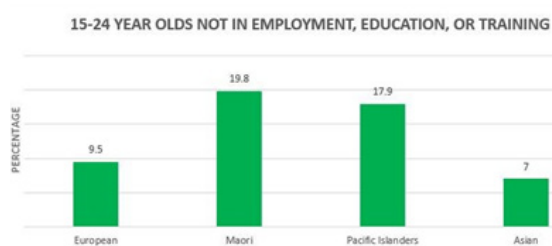


Figure. 1. 06. Graph showing NEET results for NZ youth

Manuka Henare states;

*“You’re likely to remain in poverty if you come from poverty, unless there are extraordinary interventions so people are able to go get themselves qualified and ready for the labour market,”*  
(Enoka).

#### Education:

New Zealand sits 16th out of 22 in OECD (Organization for Economic Cooperation and Development) rankings for graduates, with only 66% of University students expected to graduate (Speedy). Liz Morris, director for Diocesan School career development services, says students often feel pressure from family and friends to attend university, however are not prepared for the realities of tertiary study and also are not certain on their chosen course of study (Speedy).

While 34% of New Zealand youth are accumulating expensive student loans and not graduating with a degree, the ethnic group with the highest percent not in employment or education are Maori. The reason these young people are not seeking employment, further education or training after secondary school, is often due to poor financial circumstances,

uncertainty or lack of purpose. The NEET rates shown (see Figure 1.05) are used as an indicator for youth disengagement; the young people represented often turn to crime, with 2,488 either given an order or charged in court in 2015 (NZ.Stat).

#### Living trends:

Of these Maori and Pacific Island youth, many live in multi-generational housing, where two or more people share a room and two or more generations live together for longer periods of time than usually expected. Not only is this due to cultural norms but also housing unaffordability and low incomes. An example of co-living amongst Maori, can be seen in traditional Maori meeting houses or Maraes, where many people across all generations would meet, socialise and live together in large groups within one open space (Schrader).

Research has shown that due to traditional living trends and cultural norms, Maori and Pacific Islanders are more comfortable living together than some other ethnicities in New Zealand (Schrader). However, due to the current housing issues in New Zealand, even those who leave home and obtain degrees or other training, are increasingly returning home to live with family or flatting for longer periods of time to save money, or fundamentally have a roof over their heads. Co-living is

also increasing amongst the elderly, who often move in with their adult children as retirement villages and rest homes are viewed as unsuitable and expensive. This suggests that New Zealand may be going through a cultural shift triggered by the increasing Maori and Pacific Island communities and the desires for children to keep their elderly parents in their own homes.

As such it appears, co-living is becoming more popular in New Zealand amongst a larger variety of ethnicities and generations than previously seen, not only amongst cultures who desire and are accustomed to co-living, but also amongst those who simply require a place to live. This is occurring despite New Zealand having no specific architectural model for co-housing or multigenerational living (Branz). For young people that grow up in a co-living environment, leaving home or embarking on further education can be an isolating and lonely experience, hence not continuing study or returning home. Therefore there is great value in co-living and multi-generational living, through the connections made and sense of belonging.

## **The Proposition**

Despite New Zealand being a developed nation, the current and projected levels of unemployed and uneducated, non-job ready or trade qualified youth is worrying. Taking this into consideration along with a high level of non-graduating students, limited job availability, an increase in the number of occupants residing in houses that are designed for the typical New Zealand family (post war housing model), and a housing crisis, it is clear that action is necessary. These issues effect housing in many ways:

- Young people are unable to save for a deposit on a home due to a high level of debt or lack of funds, resulting from high student loans, a lack of education or unemployment.
- Unrealistic number of occupants per household.
- Increasing numbers of renters.
- Pressure on land – less land available in key urban areas where employment opportunities and access to services and transport is most desirable.
- People are forced to live further from their place of work/education with poor public transport options.

*“The Government needs to embark on a massive state-backed building programme to flood the market with affordable homes for first home buyers” (Twyford).*

If the New Zealand homeownership dream as it stands is no longer viable, an alternative housing option needs to be established that responds to the above issues. As Phil Twyford states above, state assistance for housing is necessary to ease pressure on young people seeking home ownership. Considering the widespread implications for the economy, community and personal security, along with the negative psychological effects of the sense of failure or unhappiness when one cannot own a dwelling to reside in, or is forced to live continuously under the burden of rental payments, solutions for affordable homes and homeownership is indeed an urgent issue.

This thesis looks at an alternative method for home ownership; a long term housing option for young people that is affordable, adaptable and can be owned in a reduced period of time, which adapts to a desired way of living. It is not only a tool to help young people into home ownership, but a tool for their future, where their home can be carried through life, adapting to which ever situation they may be in at any point in time.

## AIMS & OBJECTIVES

1. To provide an affordable housing option for young New Zealanders in response to the current housing crisis.
2. To establish a housing solution that can be assembled by the user and adapted to various situations arising throughout one's life.
3. To refine living spaces and determine the minimum space necessary for an individual user to live and complete day to day tasks in, comfortably and efficiently.
4. To advocate multi-generational and co-living within New Zealand homes, fostering inclusive environments.

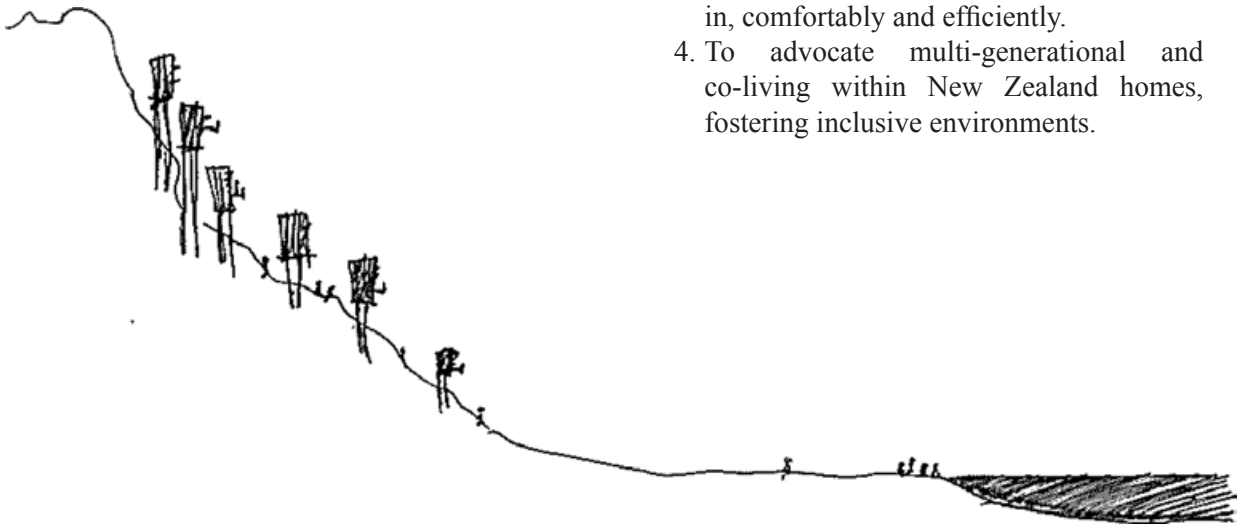


Figure. 1. 07. Concept sketch of small housing in an extreme site.

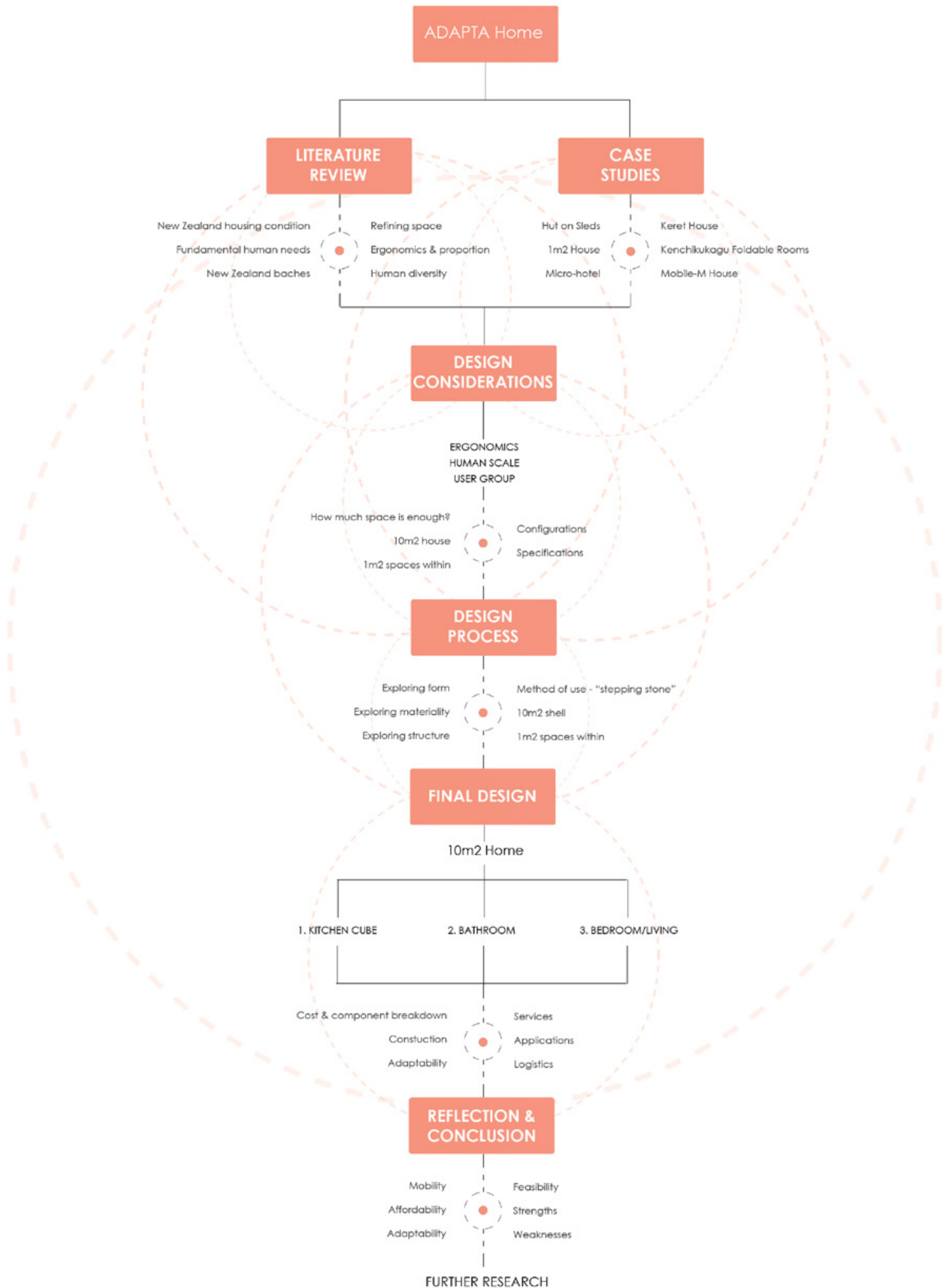


## **SCOPE**

This research looks at the housing crisis in New Zealand and focuses on the consequent problem of young New Zealanders not being able to afford their own homes. Exploration includes looking at traditional New Zealand bach dwelling, refined living, scale and proportion, housing affordability, adaptability, various applications and logistics.

These influence the design outcome for an affordable and refined housing solution for young New Zealander's.














# CHAPTER TWO

## LITERATURE REVIEW & CASE STUDIES





## LITERATURE



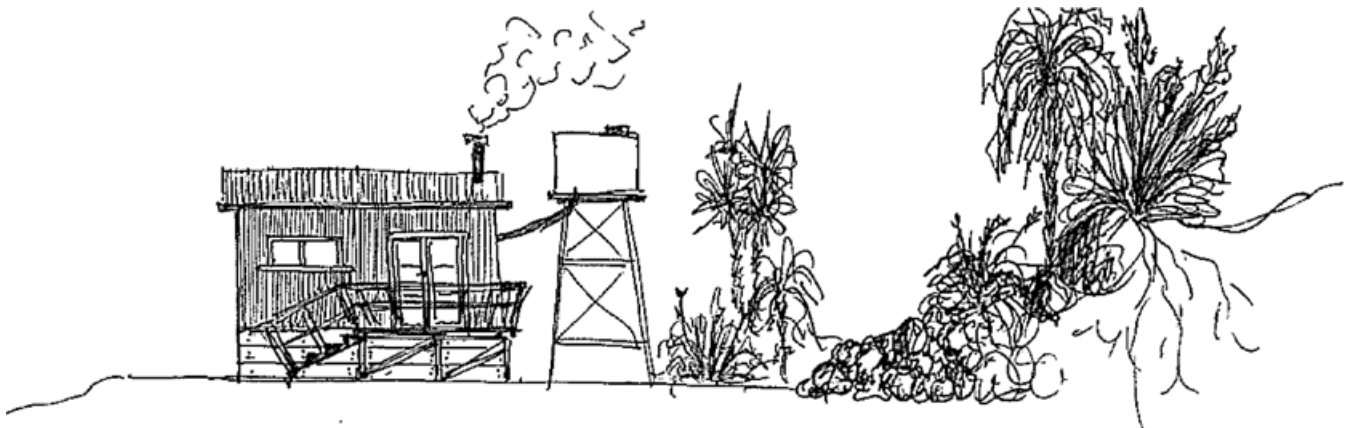
Figure. 2 .01. NZ Railway poster promoting living in the suburbs.

Figure. 2 .02. (Opposite) Sketch of old NZ hut/bach.

## Opening Statement

The current preferred housing model in New Zealand has remained the same as that seen as ideal since the 1950's housing boom. Known as "the Kiwi Dream", it is where one owns a standalone suburban home on a quarter acre section. This however, is no longer a viable, affordable or sustainable option. Unfortunately the New Zealand Government's solution to the housing demands of a growing population, is to continue building large suburban homes further away from city centres. This is also evident in the latest statistics from Statistics New Zealand, which shows New Zealanders are building less homes, but larger in size, suggesting that less people can afford to build new homes, and those that can are building in excess. Data shows that of the 30,000 homes built in 2016, the average house size was 182m<sup>2</sup>, up from the 38,000 new homes built in 1974 with an average floor area of 110m<sup>2</sup> (StatisticsNZ). This increase in house sizes is not sustainable. Not only does it cost

more to build larger, but there are high costs for infrastructure, additional amenities and cost of extra suburban land. A more suitable option is intensification of already existing environments, where higher density dwellings can make use of already existing infrastructure and communities. The main issue with intensifying housing in New Zealand, is that New Zealanders are not attracted to higher density living. The main reasons for this are the many poor examples of medium to high density housing and the perceived lack of space and privacy. Compared to other cultures, New Zealand Europeans tend to be more private, desiring their own individual space, separated from others which often leads to isolation and loneliness, particularly amongst elderly residents (Statistics NZ).



## **Fundamental Human Needs**

When looking specifically at human needs, the most basic but fundamental requirements for living are outlined in Abraham Maslow's Hierarchy of Needs (see Figure 2.03) as being physiological. These include access to food, water and sanitary services. For New Zealand as a developed nation, these would be considered as access to services, amenities and an income for food and living expenses. These basic needs are fundamental to survive, however, do not mean that one will live happily or comfortably. The second tier of basic needs relates to safety, including security, morality and health. These translate to a more architectural concept of having a home/shelter and warmth, leading to a more comfortable living environment. The third and fourth levels of Maslow's Hierarchy of Needs are psychological, such as feeling a sense of belonging and esteem. These needs are more specific to the interactions and connections between people and place, whilst also being confident and satisfied, which could be achieved architecturally by owning one's own home and being part of a community. The top level and most important is self-fulfilment and self-actualisation, achieved through creativity, morality and problem solving, where one can achieve their full potential (McLeod).



Figure. 2 .03. Maslow's hierarchy of needs triangle

## The New Zealand Bach

Placing human needs in a hierarchy establishes a set of levels off which to design to, according to what people need in space and how space can be refined, whilst meeting the fundamental needs of the user. An example of a raw and refined housing typology in New Zealand can be seen in traditional holiday baches, as Paul Thompson outlines as having “a porch, a view, a sea or mountain breeze and basic washing and cooking facilities” (Thompson, 3). From Thompson’s definition of a traditional bach, it is evident that connection to place is of more importance than an associated style, scale or status, aligning with Maslow’s Hierarchy of Human Needs. However, over time, a

change in values has altered the aesthetic of the “iconic Kiwi bach”, which is no longer a basic structure on temporary land with an undefined boundary, allowing a connection between neighbours. Today’s baches, or more namely “holiday houses”, are looking increasingly like the everyday homes people have departed from. With curbed roads, underground services, fences, manicured lawns, televisions and a million dollar price tag, the essence and rawness of the bach and the holiday has become more organised and commercialised (Thompson, 5-6). The desire to occupy and observe a view from a place of containment arose from the basic need for shelter and security, however, with land under more pressure than previously seen, land is no longer occupied in the same casual nature (Cheshire, Reynolds, 8-9). This has pushed land prices higher, making holidaying only available to the wealthy and status concerned, with the desire to have more than basic needs.

*“I fear we have forgotten why we come to these places; forgotten the restorative effects of change and the value of simplicity. Our destinations look increasingly like the places we left” (Cheshire, Reynolds, 9).*

## Refining Space



With holiday homes now full of luxuries, excess space and amenities, and a high price tag, it is necessary to review the components of what is truly needed in New Zealand homes and what can be done without. Le Corbusier's fundamentals for living suggest a space for cooking, eating, working, sleeping and bathing (Renzi). However, some of these individualised spaces according to use, can overlap, reminiscent of the multi-use spaces within traditional New Zealand bachs:



*“A room that is both entry and kitchen, an abrupt transition from out to in; abrupt in daylight, but uncommonly so at night as one fumbles for the switchboard (Cheshire, Reynolds, 13).*

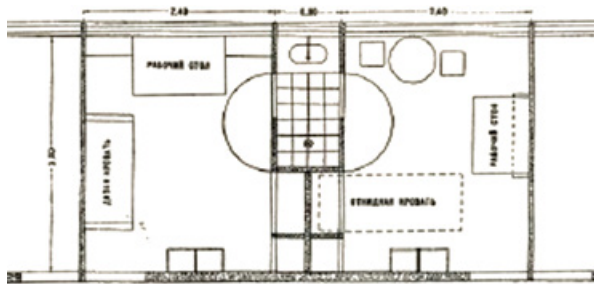
What and how much an individual needs in space depends on one's culture and willingness to adapt. In “The Communist Egosphere”, Nikolaj Miljutin's design for his “Living Cell” demonstrates a way of living most New Zealander's are not accustomed to, however it is an efficient and interesting housing model. The single room Living Cell was a Russian

Figure. 2 .04. (Top Image) Traditional small scale New Zealand Bach, with no defined boundary - Hatepe Bach.

Figure. 2 .05. (Lower Image) Large Rotorua holiday home for rent.

Figure. 2 .06. (Opposite) Nikolaj Miljutin, Living Cell in Russia, 1930.





design in 1930 and measured only 8.4m<sup>2</sup> in floor area (Sloterdijk, 3). It eliminated the family and marriage, focusing on the individual user and alliances made according to personal preferences (3). The inhabitant is said to be in a constant relationship with the interior, operating the home through physical labour by opening, closing, sliding and folding parts, such as built in furniture (4). It is as though the user lives in locomotion, not bound by a collection of possessions, instead living like a nomad (4). All spaces within the space overlap to become one open zone, functioning according to the activity of the user, i.e. a bedroom or a lounge and a kitchen or a dining space.

## Ergonomics & Proportion

Designing small and refined living spaces such as Miljutin's Living Cell requires the analysis of ergonomics and human proportions. This begins with Marcus Vitruvius Pollio (more commonly known as Vitruvius) and his measurements of the human body relating to architecture. As stated in "The Ten Books on Architecture", Vitruvius believed that measurements of the human body are distributed by nature and should be directly translated into the proportions of a building, in order to create beautiful architecture (Pollio, 72). This concept developed into "The Vitruvian Man", visually interpreted by Leonardo Da-Vinci (see Figure 2.09) according to the specific human proportions outlined by Vitruvius:

- 4 fingers = 1 palm
- 4 palms = 1 foot
- 6 palms = 1 cubit (forearm to middle finger tip)
- 4 cubits = height (24 palms)
- 4 cubits = 1 pace (74).

The projection of the human body into architecture was again adopted by Le Corbusier, who developed the Modulor Man in 1945 (Cohen). Le Corbusier meant for the "Modulor" to be a universal system of proportions, developed as a visual bridge between two incompatible scales; the metric and imperial (Cohen). Imperial measurements were linked to the Vitruvian model of grounding measurements in the proportions of the human body (Richards, 101). The Metric however, was considered unhuman and disconnected the body from architecture (101). The Modulor man put the human form back into architecture, which after all is designed to accommodate the human form.

Historical traditions such as the Vitruvian Man and Modulor Man are prescriptive, dealing with an idealised human being as they ought to be according to a pre-existing aesthetic or metaphysical principle, rather than real human beings as they are (Pheasant and Haslegrave, 8).



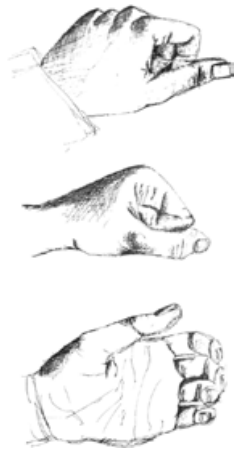


Figure 2 .07. Hand study sketch.

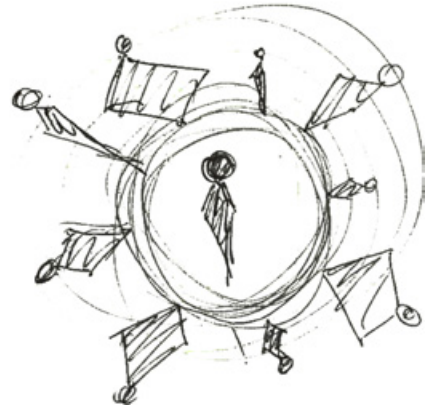


Figure 2 .08. User centred design and human diversity sketch.

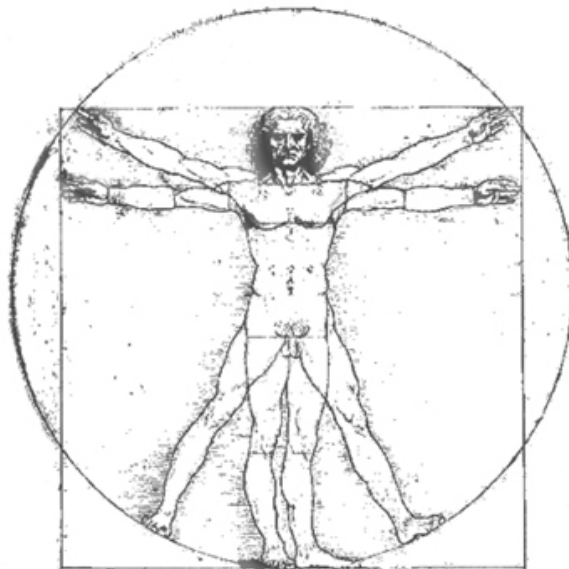


Figure 2 .09. Vitruvian man visually represented by Leonardo da Vinci.

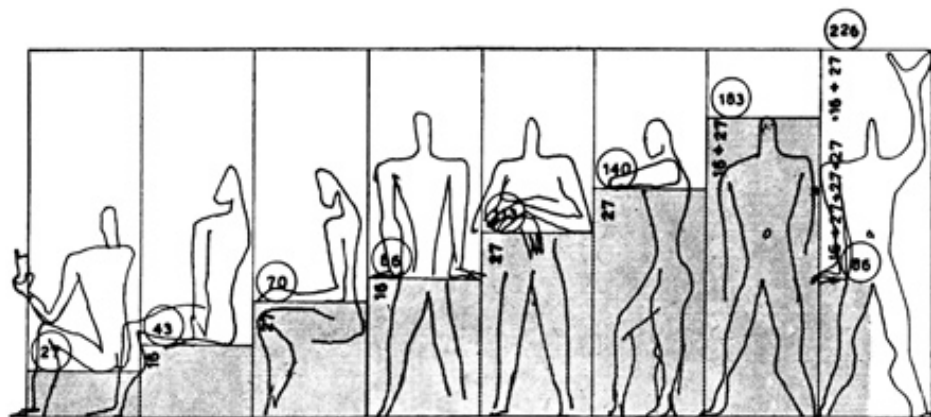


Figure 2 .10. Ergonomic sketches of Le Corbusier's Modulor Man Concept.

Albrecht Durer, a painter, printmaker, and theorist, realised through his engraving of “Adam and Eve” in 1504, that information given by Vitruvius was flawed and could not establish a universally valid law of proportion (National Library of Scotland). Durer began a study of nature using precise measurements of large numbers of men, women and children (National Library of Scotland). He established technical mathematical systems relating to an individual’s height, forming a unit of measurement specific to that person and therefore differing from person to person (National Library of Scotland). Durer was primarily concerned with matching physical form and the dimensions of the product or workplace, to that of its user (Pheasant and Haslegrave, 7).

Because architectural inhabitants are not limited only to six-foot men, but also include women, children and elderly, Durer’s research is more relevant. As stated in “Bodyspace” by Stephen Pheasant and Christine M. Haslegrave, humans are variable; therefore user centred architectural design requires an understanding of that variability and must design to accommodate it (7).

*Anthropometry: measurement of the human individual, particularly measurements of body size, shape, strength, mobility, flexibility and working capacity (9).*

In Louis Sullivan’s words, “form follows function”, which suggests functional considerations alone are enough to determine an objects form and ornament is therefore superfluous (9). In contrast, Maslow’s Hierarchy of Needs places creativity and self-actualisation as most important and furthest from the basic functional human needs, instead celebrating the importance of creative processes. Because human beings are adaptable, i.e. a tall person can duck through a doorway (12), variability needs to be accommodated for, which can be achieved through empirical design; a way of gaining knowledge by means of direct and indirect observation or experience (12). Pheasant and Haslegrave discuss two constraints, the first being a “one-way constraint” which accommodates all users without adjustment, such as a tall doorway to accommodate tall users, without effecting short users (26). The second, a “two-way constraint” where the two limits must be designed for, such as a chair

that can adjust for a tall or short user. Pheasant and Haslegrave go on to outline four main human ergonomic characteristics that should be designed for, according to a one or two-way constraint:

1. Clearance (one-way constraint): Having adequate head room, elbow room and leg room, access and circulation space. Handles must provide adequate apertures for the fingers or palm (26).
2. Reach (one-way constraint): The ability to grasp and operate. Visual reach = distances for reading (legibility or screens/text). The shortest reach constraint will also satisfy the larger percentage of the population (26).
3. Posture (two-way constraint): Limited by the individuals body dimensions and the relationship to the object/component.
4. Strength (one-way constraint): If designed for the weakest user then the strongest can also use it. A two way constraint may apply in order to fulfil the comfort of the strong user; i.e. to prevent accidental operation of controls (27).

Strategy to take forward:

- Design for the limiting user (one-way constraint).
- Define an area of common fit (two-way constraint).
- Provide adjustment (two-way constraint).

## **Key Findings**

Through this research, it is clear that the typical and traditional New Zealand housing model needs to change. There needs to be a shift away from large, standalone homes on individual sections, to a more refined and downscaled model, designed with specific focus on user experience and liveability. The statistics showing an increase in dwelling sizes and decrease in the amount of dwellings built, suggests that for young people seeking homeownership, a reduced scale in housing and therefore reduced costs, could enable more affordable housing and higher numbers of it.

As presented in the research on traditional New Zealand baches, refined living promotes a greater user experience and connection to place. In a smaller housing model and refined living style, it is necessary to approach the ideas presented by Maslow and Durer, relating to human needs and human scale, designing specifically to accommodate all users rather than a particular individual.



Figure. 2 .11. Sketch showing human variety and diversity.



## CASE STUDIES

## HUT ON SLEDS

*Ken Crosson - New Zealand*

An eroding coastline and strict council regulations meant this 40m<sup>2</sup> bach for a family of 5, was to be able to move away from the beachfront when necessary. This resulted in the design of two large sleds, allowing the hut to be dragged back and forth via tractor.

With rising sea levels and eroding land a prevalent issue around New Zealand and further afar, resilience is becoming a more popular design trend in today's architecture and interpreted as 'mobility' in this case, from impending dangers. In addition, the ability to move a home from one location to another at a minimum cost with little impact to the site, and not involving large removal and installation costs associated with traditional house moving, is a desirable option.

### Key Characteristics:

- Small scale (40 m<sup>2</sup> for 5 people)
- Mobile
- Structure as architecture/storage
- Lightweight construction
- High Stud – uses vertical space
- Connection between indoor and outdoor
- Security/privacy
- A place to eat, sleep, bathe, live





Figure. 2 .12. Hut on Sleds - Closed.



Figure. 2 .13. Hut on Sleds - Open.



Figure. 2 .14. Tractor towing Hut on Sleds.



Figure. 2 .15. Open hut during evening.

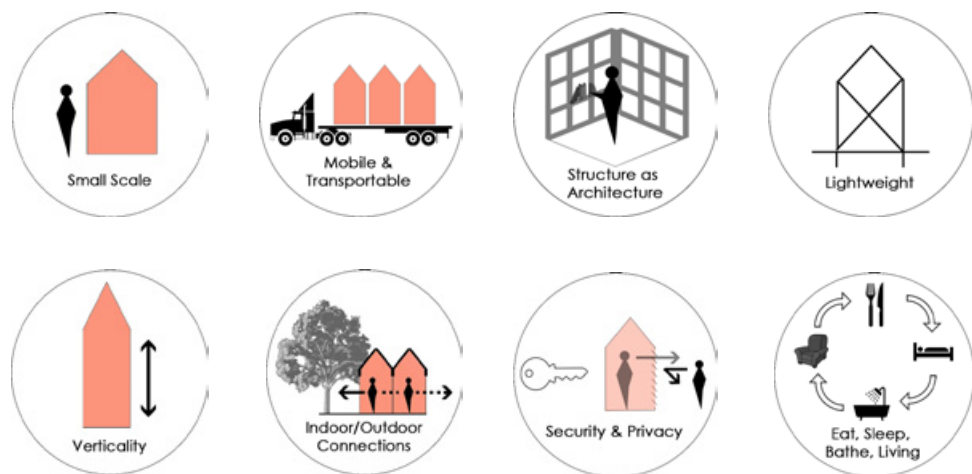


Figure. 2 .16. Diagrammatic key showing specific case study characteristics.

## ONE SQM HOUSE

*Van Bo Le-Mentzel - Berlin*

Pushing the idea of a home to the absolute limit, the 1 metre squared do-it-yourself structure, can be put together with a cordless screwdriver and saw. With a total weight of 40 kilograms, the structure can be moved wherever the user may desire.

The concept of space and how much one truly needs, is a relevant topic as globalisation and limited available land, pushes people to live with less and in smaller spaces. The cost for heating or cooling of smaller spaces becomes cheaper and easier to maintain, making them more sustainable options. They also become sustainable in situations such as job loss, low incomes, ill health and disability.

### Key Characteristics:

- Micro scale 1m<sup>2</sup>
- Mobile/transportable
- User centred/single user
- Prefabricated
- Flexible
- Easily multiplied



Figure. 2.17. 1m2 house - Configurations.



Figure. 2.18. 1 sqm house mobility.

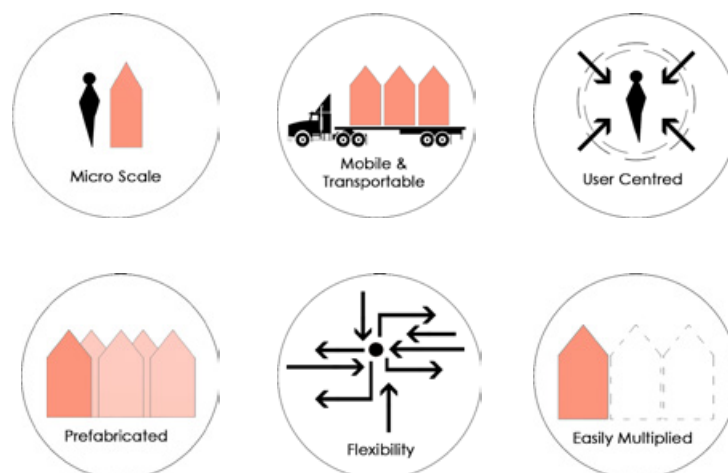


Figure. 2.19. Diagrammatic key showing specific case study characteristics.

## MICROHOTEL

*Kutarq Studio- Spanish Concept*

Easy assembly on site is the main concept of the Microhotel, therefore elements are modular in nature and prefabricated; allowing for simple transportation to site on a truck and trailer. An open floor plan means the interior space is flexible, with a rail system allowing for a module to slide out, creating extra space.

Prefabricated, modular design is an efficient building method, allowing for fast production and delivery to site, in response to the housing demands of today. It is also a cheaper and cost effective response to housing. If designed accordingly, prefabrication can allow for easier expansion and a reduction in house sizes.

### Key Characteristics:

- Adjustable/flexible
- Small scale (10m<sup>2</sup> for 1 or 2 people)
- Transportable
- Prefabricated
- Open floor plan
- Connection between indoor and outdoor
- Secure
- Easily multiplied/connected to one another.



Figure. 2 .20. Microhotel Perspective Render

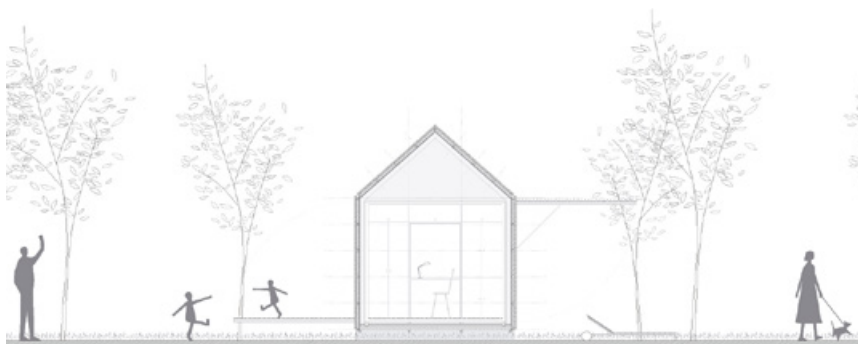


Figure. 2 .21. Microhotel End view - openings for deck & shelter.

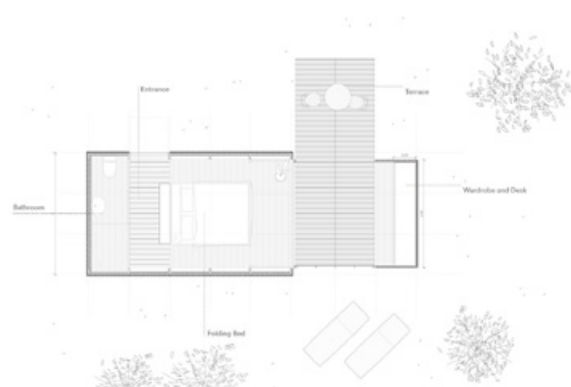


Figure. 2 .22. Microhotel Floor plan - fully open.

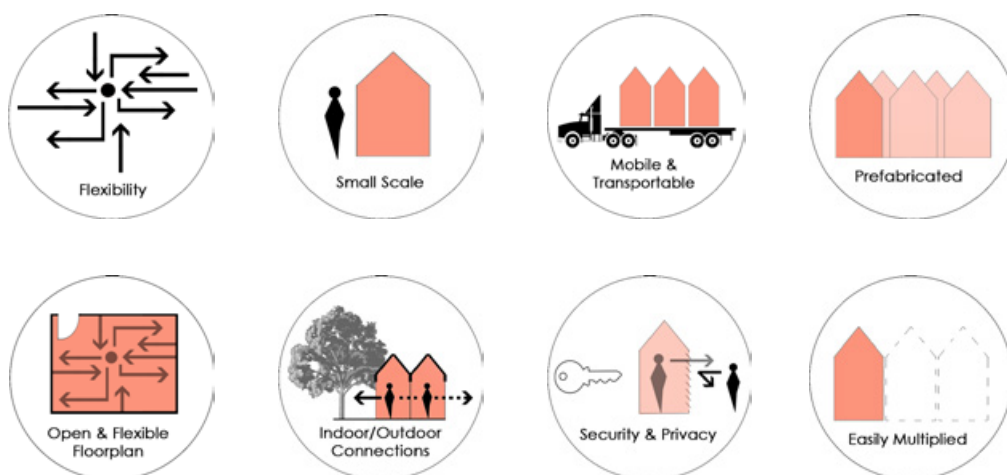


Figure. 2 .23. Diagrammatic key showing specific case study characteristics.



## KERET HOUSE

*Jakub Szczesny - Poland*

A narrow site resulted in the design of the 1.2m (at widest) Keret house, also known as the world's smallest house. The Keret house is elevated off the ground, making for a secure and private place of entry. The height of the space, openings, details, colour choice and materiality give the narrow space a larger sense of scale.

Limited buildable land and space is an issue prevalent around the world, with different cultures having different appreciations of space and ideas of how much each individual needs, to complete their everyday tasks. The ability to build on smaller sections, or sub-dividable backyards is increasingly becoming a solution to the shortage of land and increasing land prices. Efficient space design and creative solutions, efficient use of materials and resources in smaller homes and spaces, is an important challenge for designers/architects.

### Key Characteristics:

- Micro scale – 1.2m width
- A place to eat, sleep, bathe, live
- Elevated – extra ground space
- Lightweight steel structure
- High stud – uses vertical space
- Secure and private



Figure. 2.24. Keret House - Perspective revealing structure.

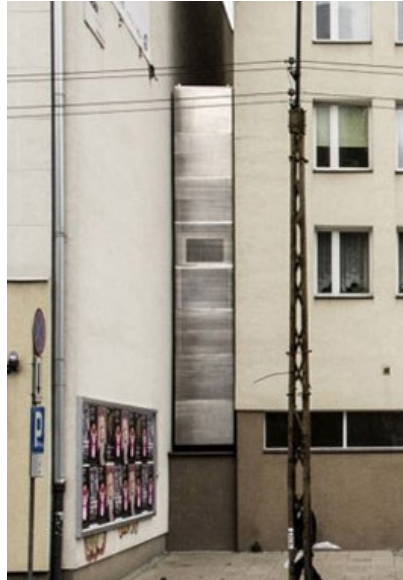


Figure. 2.25. Keret House – Between two buildings.

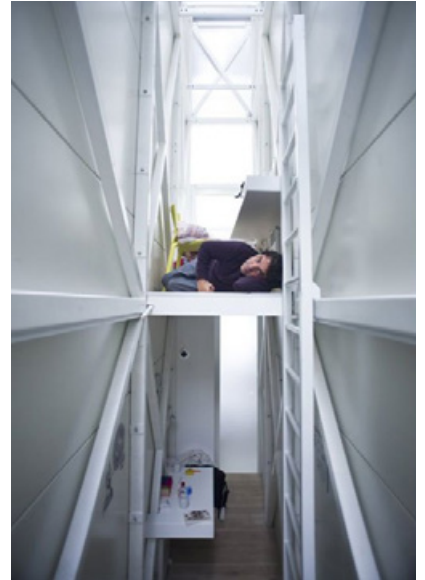


Figure. 2.26. Keret House – Interior view.

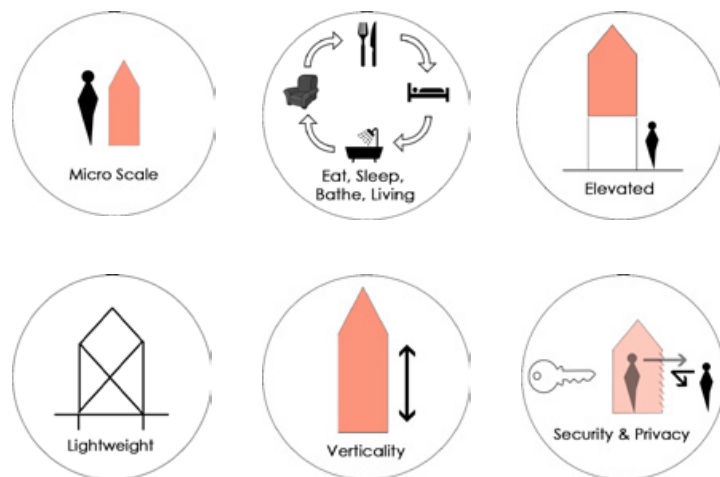


Figure. 2.27. Diagrammatic key showing specific case study characteristics.

## KENCHIKUKAGU FOLDABLE ROOMS

*Toshihiko Suzuki - Japan*

Limited space drove the design of the Kenchikukagu Foldable Rooms, created with the idea that a single user can perform all daily tasks in one room. Each compact space is refined to a set of absolute fundamentals, eliminating unnecessary clutter and costs.

Although not desirable for all users and dependent on social and cultural background, refined space and minimal material is a more efficient and cost effective way to live, again in response to limited buildable land and living spaces. Through creative design solutions considering materiality, scale and detail, limited living space does not need to be seen as a disadvantage, but instead an opportunity to enhance the interactions between user and product.

### Key Characteristics:

- Micro scale – minimum space
- A place to eat, sleep, work
- All contained in one room
- Flexible
- Mobile/transportable
- User centred
- Prefabricated





Figure. 2 .28. Folding & mobile Kitchen, Office & Bedroom.



Figure. 2 .29. Closed for storage: Kitchen, Office & Bedroom.

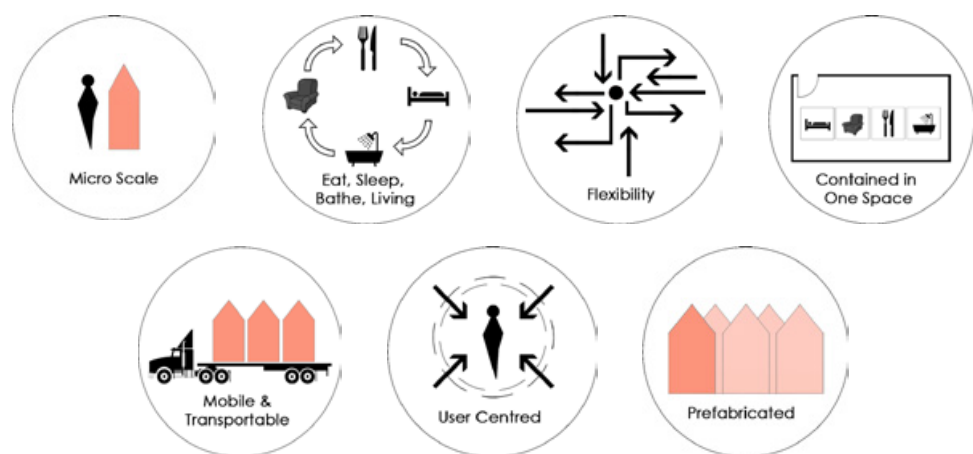


Figure. 2 .30. Diagrammatic key showing specific case study characteristics.

## **MOBILE M-HOUSE**

*Michael Jantzen - Concept*

Designed to demonstrate how prefabricated design can easily be transported to almost any site, the Mobile M-House can be arranged in any way desired and manipulated according to both the needs of the user and the site.

The ability to transform and alter the architecture of one's home, is an exciting option for many, directly involving the user with their surrounding environment, making for a more active living space. Mobility in design creates opportunities to move between various locations dependant on the desires or needs of the user, as well as eliminating expensive costs associated with traditional house relocating.

### Key Characteristics:

- Small scale – add to or remove
- Transportable
- Basic steel structure
- Adjustable/flexible
- Prefabricated
- Connections between indoor and outdoor
- Elevated – extra ground space
- Adaptable
- Can be multiplied



Figure 2 .31. Transportation via Truck & Trailer



Figure 2 .32. Steel structure with opening & closing facade panels.

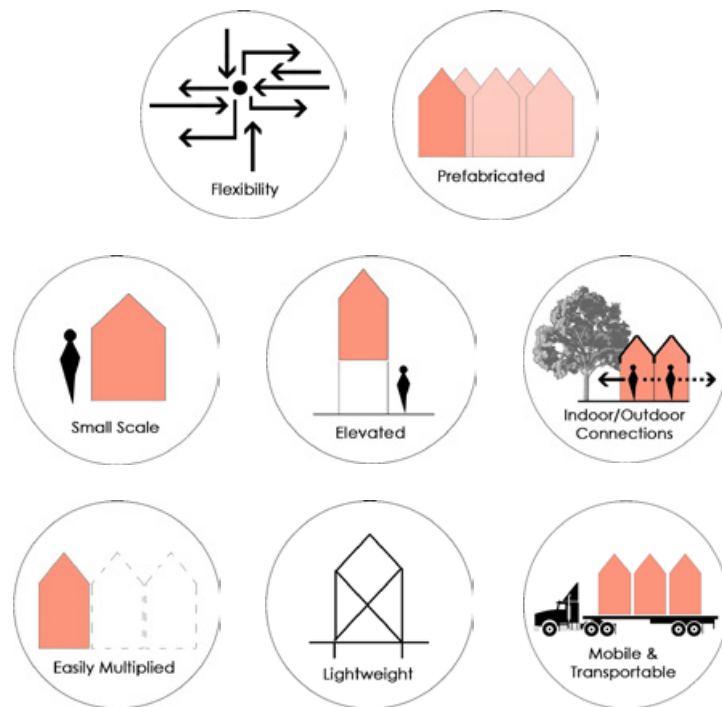
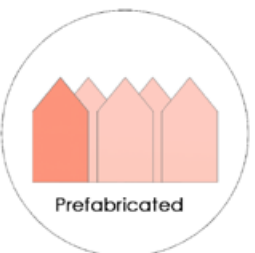
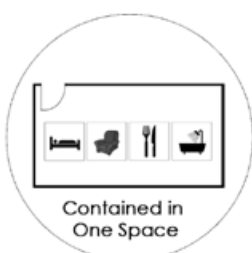
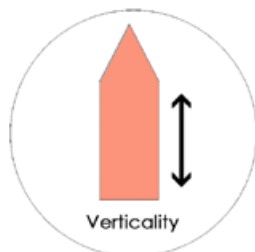


Figure 2 .33. Diagrammatic key showing specific case study characteristics.

## KEY FINDINGS

Through the analysis of the previous case studies, it is evident that mobility in design is a key feature in order to adapt to various sites and environments, user desires, needs and varying situations that might arise. The small scale and refined nature of each case study demonstrates how a connection between architecture and user, architecture and place, and user and place is established. Methods such as prefabrication and modularity are seen to improve efficiency in production and transportation, therefore reducing costs and time. Adjustability and flexibility of design responds again to the user's desires or changing needs, providing a housing option that can be used for longer periods of time.

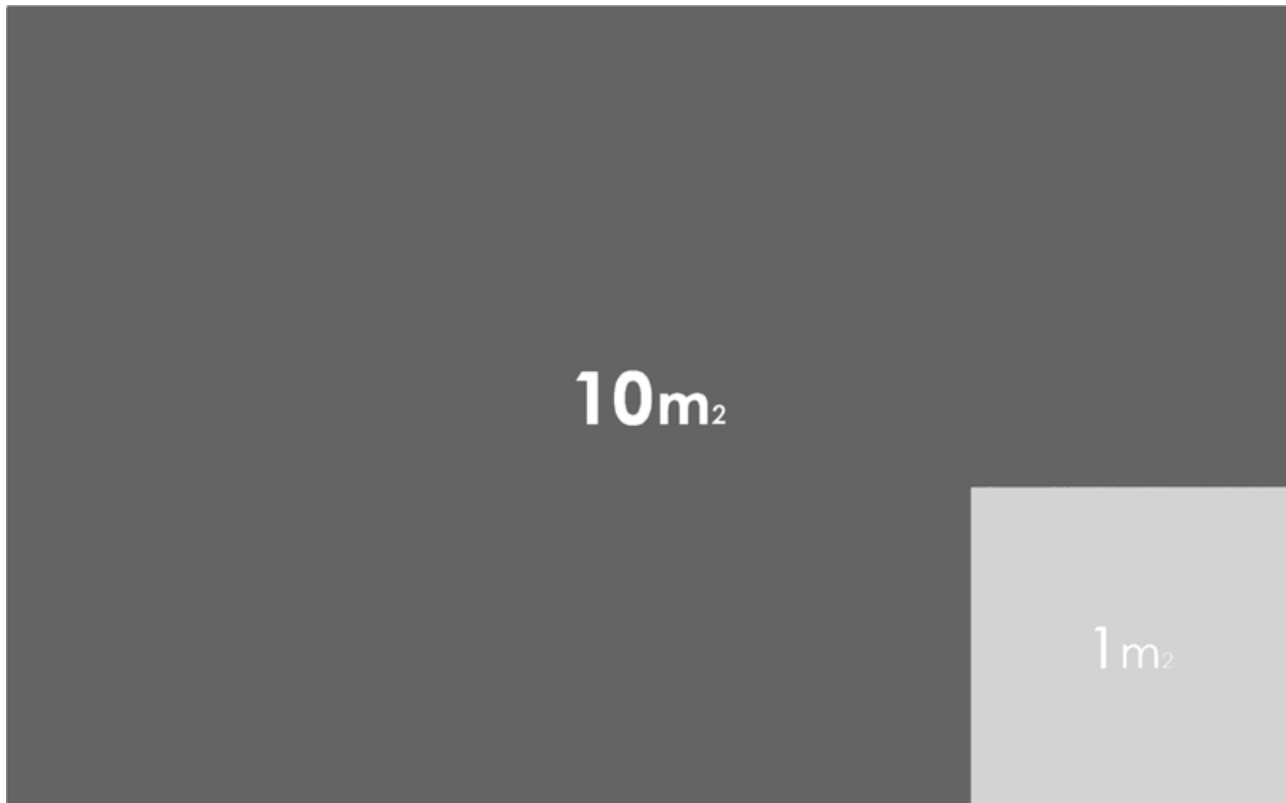






# CHAPTER THREE

## DESIGN CONSIDERATIONS



### The 10m<sup>2</sup> House

Driven by the research on ergonomics, proportion, human needs, refined living, scale, New Zealand baches and affordability, the design of a small housing option for young people in New Zealand, is the ultimate aim. The maximum size of a dwelling not requiring a permit in New Zealand, is 10m<sup>2</sup>, a small area usually intended for storage sheds or extra accommodation, provided there is an existing primary dwelling (Building Amendment Act 2013). The limitation of 10m<sup>2</sup> presents some interesting questions;

1. “How much space do we need?”
2. “Is it possible for a young person to live within a 10m<sup>2</sup> space?”

*Figure. 3. 01. Diagram showing 10m<sup>2</sup> dwelling size with 1m<sup>2</sup> interior spaces.*

*Figure. 3. 02. Small scale characteristic - informed from case studies.*



Specifications for permit-less dwellings in New Zealand:

- Single-storey detached buildings not exceeding 10m<sup>2</sup> floor area.
- Is not more than one storey (being a floor level of up to 1 metre above the supporting ground and a height of up to 3.5 metres above the floor level).
- Does not contain sanitary facilities or facilities for the storage of potable water.
- Does not include sleeping accommodation, unless the building is used in connection with a dwelling and does not contain any cooking facilities.
- Does not include building work in connection with a building that is closer than the measure of its own height to any residential building or to any legal boundary (Building Amendment Act 2013).

## The 1m<sup>2</sup>



The idea of using only 1m<sup>2</sup> of space, is drawn from the “1m<sup>2</sup> House” case study, by Van Bo Le-Mentzel.

A one metre square of floor space is used to test the ergonomic constraints outlined in “Bodyspace”; Clearance, Reach, Posture, Strength.

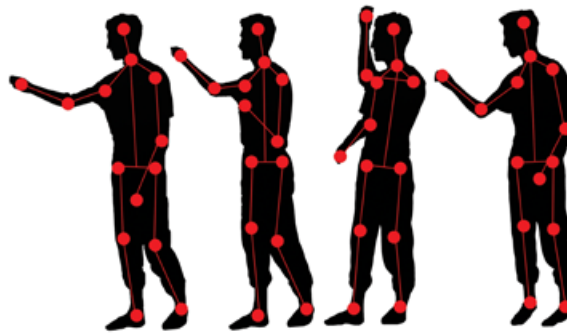
1. Can the spaces within our homes, be contained within 1m<sup>2</sup>?
2. How much space do we really need?



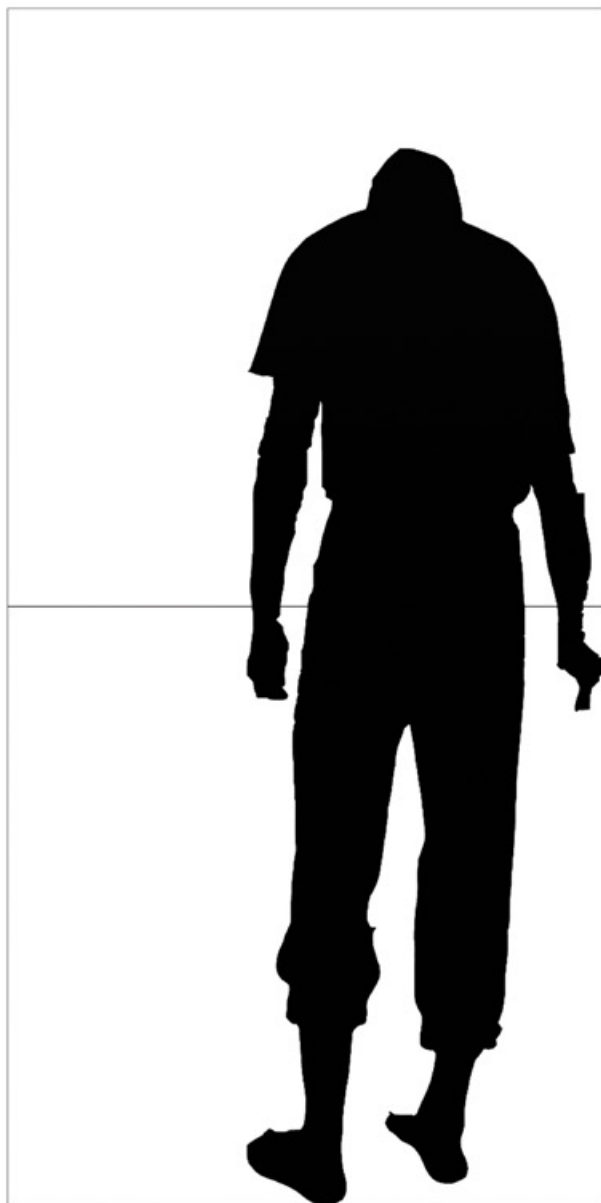
*Figure. 3. 03. 1m<sup>2</sup> area of space*

*Figure. 3. 04. Micro scale & user centred characteristics - informed from case studies.*

*Figure. 3. 05. (Opposite) Figure study of human movements through everyday tasks.*



## Clearance



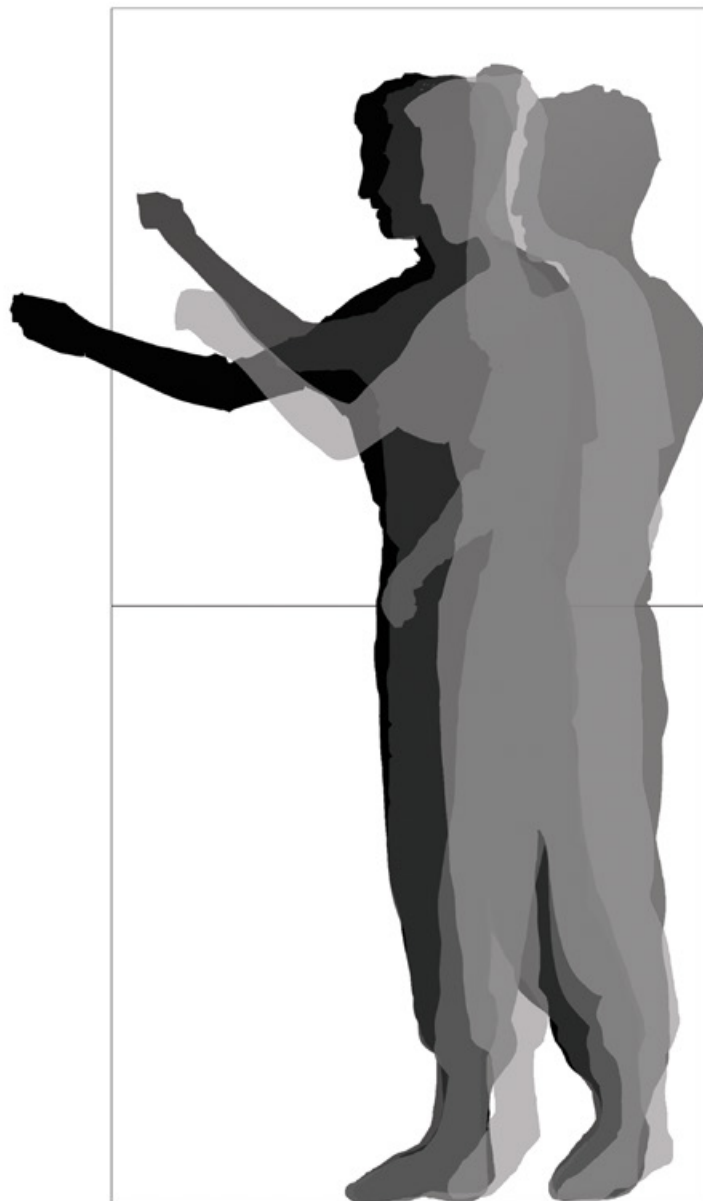
*Figure. 3. 06. Figure study showing clearance: six foot man standing in 1m2 floor area.*

## Posture



*Figure. 3. 07. Figure study showing posture: six foot man sitting in 1m2 floor area.*

## Reach



*Figure. 3. 08. Figure study showing reach: six foot man opening cupboard in 1m<sup>2</sup> floor area.*

## Strength



Figure. 3. 09. Figure study showing strength: six foot man lifting object in 1m2 floor area.

User group : YOUTH

Adaptability is a key feature and due to the variation in human beings, the dwelling should be designed to accommodate all users, of all shapes, sizes, ages and abilities.

Design components to consider:

- Pivoting doors – operable for weak & strong users.
- Wide & high doorways – access and connection, responding to human variation.
- Zero-step thresholds – access & continuity of space.
- Open & flexible layout – connecting/overlapping spaces & inviting interaction.
- Prospect/view – inviting contemplation & connection to place.
- Surface treatments – non slip.
- Easy to access services & amenities.
- Materiality, texture, light, atmosphere, warmth, privacy.

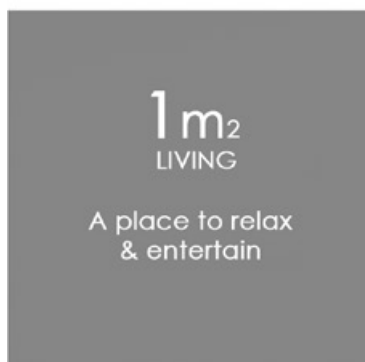
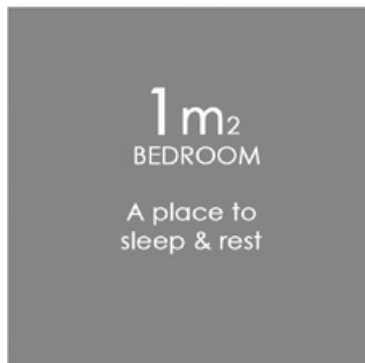


*Figure. 3. 10. Silhouette of single human user.*

*Figure. 3. 11. (Opposite) 1m2 spaces for cooking, bathing, sleeping and living.*

*Figure. 3. 12. (Opposite) Key characteristics informed by case study analysis.*





## Core Spaces of Use

Cooking, Dining, Bathing, Working, Relaxing and Sleeping.

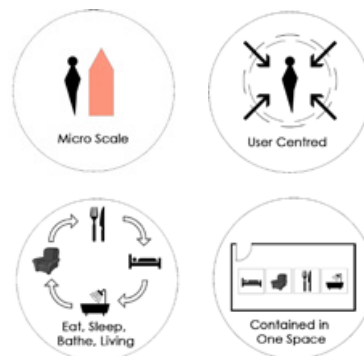
Overlapping spaces:

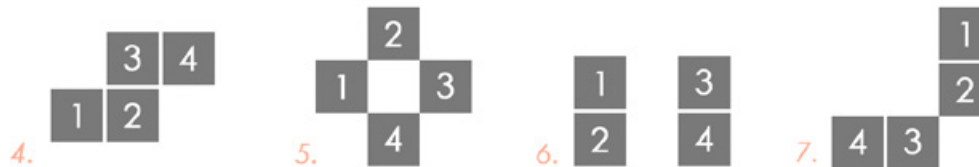
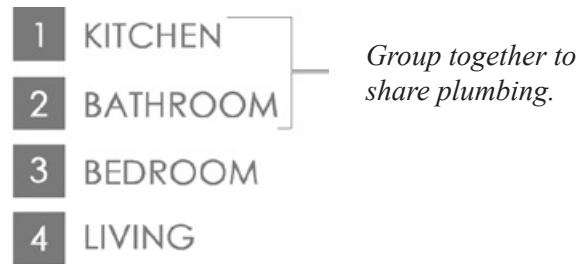
- Cook + Dine + Work
- Relax + Sleep
- Bathe.

Outcome:

- One space to cook, dine and work
- One space to rest and sleep
- One space to relax and interact
- One space to bathe

Can each task be done within 1m<sup>2</sup>?

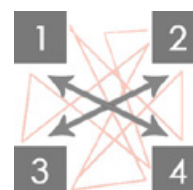


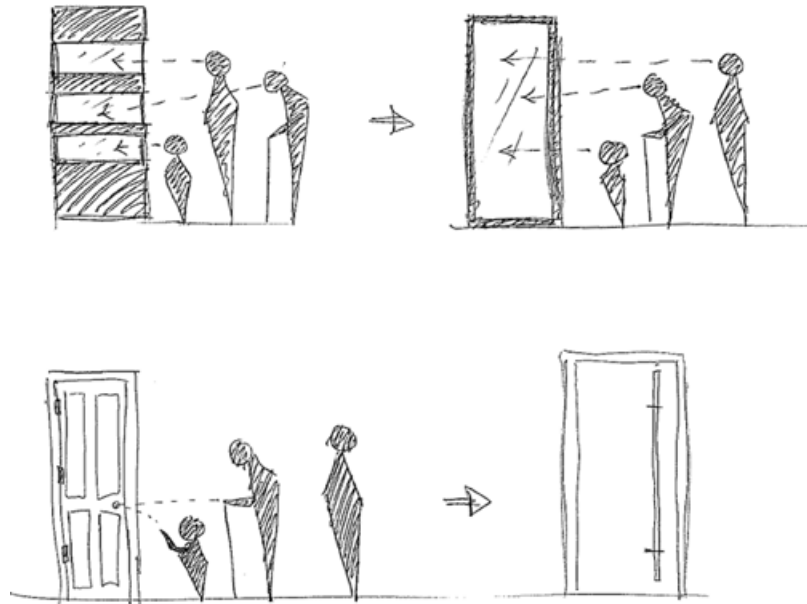


- Configuration of space is determined by program, i.e. grouping wet areas together such as the bathroom and kitchen.
- The bedroom and Living spaces can overlap, due to their similar programs, therefore the resulting combined space of 2m<sup>2</sup> can better accommodate the need for users to lay down on a horizontal plane.

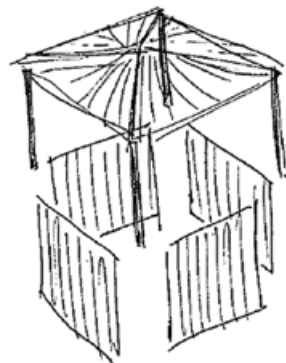


- Each space requires different levels of privacy, connection and proximity for view/prospect, security and comfort.





- Designing to accommodate tall and short users, adults, children and elderly.
- Privacy and security needs vary between users, dependent on height and ability.



Fundamental components for Living:

- Roof – shelter
- Framing – structure
- Walls – security & privacy
- Doors - access
- Windows - light & visibility

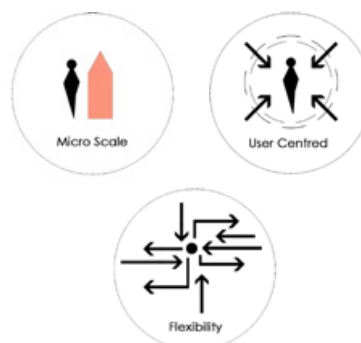


Figure. 3. 13. (Opposite) Configurations of each space.

Figure. 3. 14. Design considerations to accommodate variety amongst users.

Figure. 3. 15. Architectural components - physical fundamentals for living sketch.

Figure. 3. 16. Key characteristics informed by case study analysis.



# 4

## CHAPTER FOUR

### DESIGN CONCEPTS & PROCESS

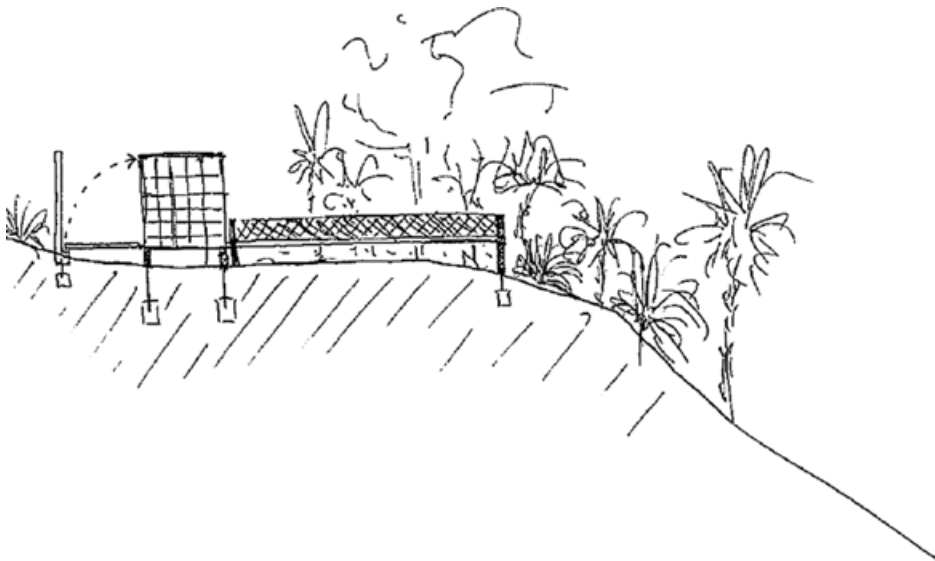


Figure. 4. 01. Design concept sketch.

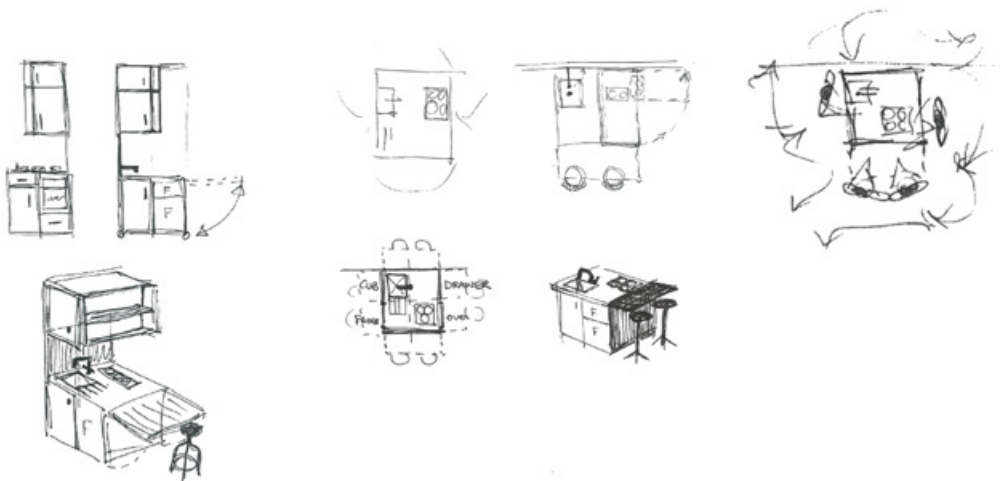
## Kitchen Concept

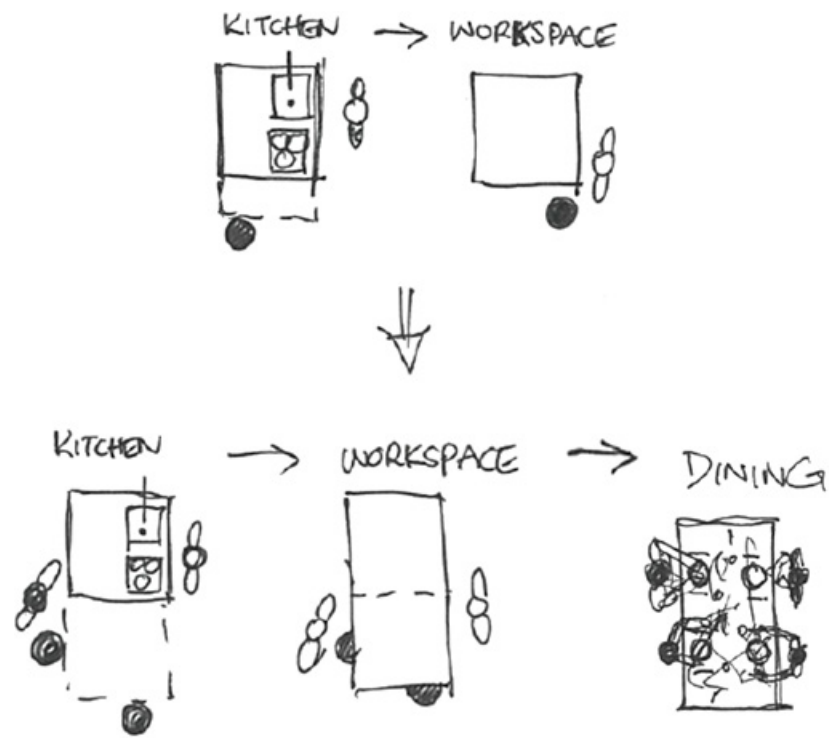


Kitchen in 1m<sup>2</sup> space, with standard kitchen dimensions and scale.



Kitchen in 1m<sup>2</sup> space, with unique kitchen dimensions, utilising entire 1m<sup>2</sup> area.





The 1 metre squared kitchen utilises the entirety of the allocated 1 metre square. The concept is for a cube that can be utilised as more than a kitchen, but also as a dining space and a work space. The adaptability responds to the variability in users.

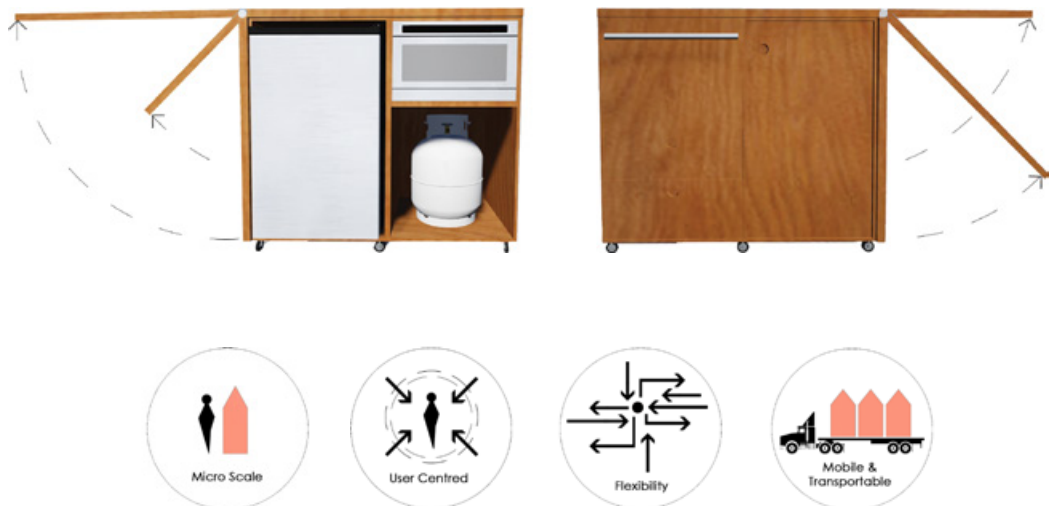


Figure. 4. 02. (Opposite) 1m2 Kitchen space limitation.

Figure. 4. 03. (Opposite) Design concepts for an adaptable kitchen.

Figure. 4. 04. Various configurations of a 1m2 kitchen concept.

Figure. 4. 05. Concept render of kitchen cube, showing side elevations and functionality.

Figure. 4. 06. Key characteristics informed by case study analysis.

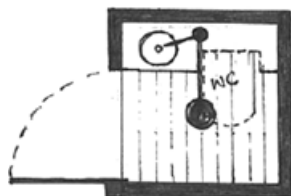
## Bathroom Concept



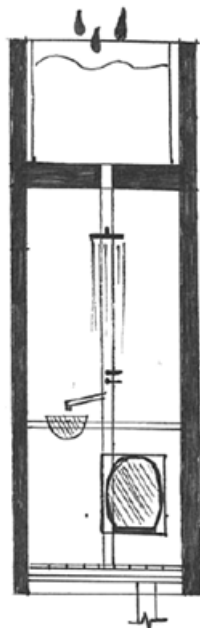
Bathroom in a 1m<sup>2</sup> space, to contain shower, sink and folding toilet.



Testing a 1m<sup>2</sup> bathroom in plan, using a 6 foot tall male to determine comfort and functionality.



Plan



Section





Although all bathroom components fit into a 1 metre squared space, through the testing of comfort and functionality, it was evident that for tall or disabled users, the space would be restricting. By increasing the size by 0.5 metres to 1.5 metres squared, the space becomes more accessible and comfortable for a wider range of users.

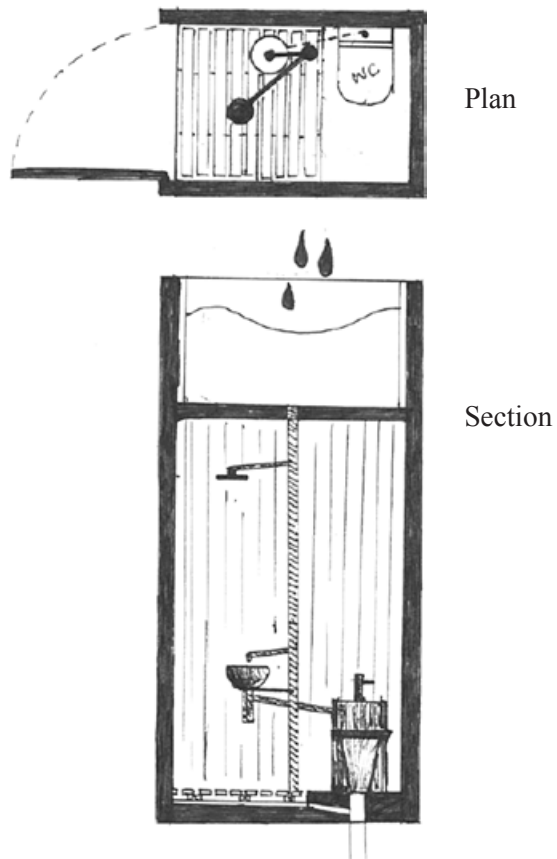


Figure. 4. 07. (Opposite) 1m2 Bathroom space limitation.

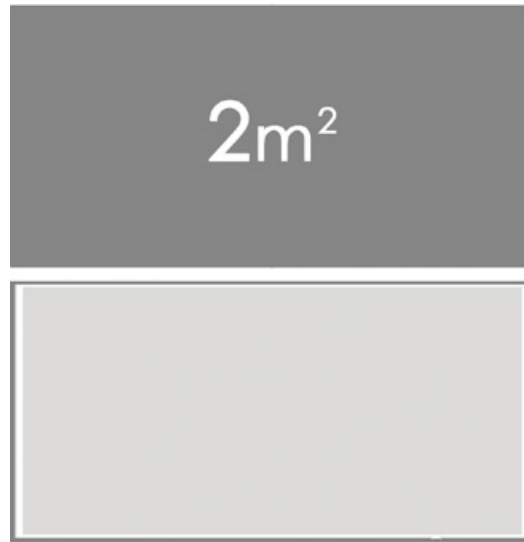
Figure. 4. 08. (Opposite) Testing the comfort and functionality of a 1m2 bathroom space.

Figure. 4. 09. (Opposite) 1m2 design plan and section.

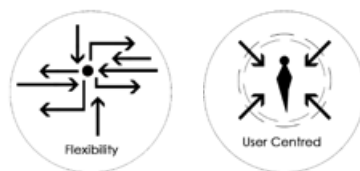
Figure. 4. 10. (Opposite) Key characteristics informed by case study analysis.

Figure. 4. 11. 1.5m2 bathroom design, plan and section sketch.

## Combined Bedroom & Living Concept



Combining the similar programs of the bedroom and living spaces, wasted and unnecessary space is avoided. The extra length accommodates the horizontal plane, i.e. lying down.

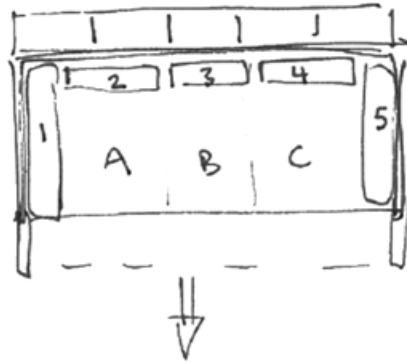


*Figure. 4. 12. 2m<sup>2</sup> Bedroom & Living space allocation diagram.*

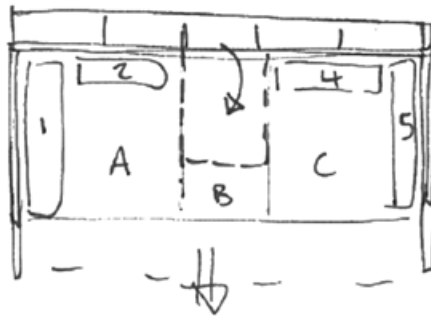
*Figure. 4. 13. Key characteristics informed by case study analysis.*

*Figure. 4. 14. (Opposite) Design concept for a combined living and bedroom space; showing various configurations in plan.*

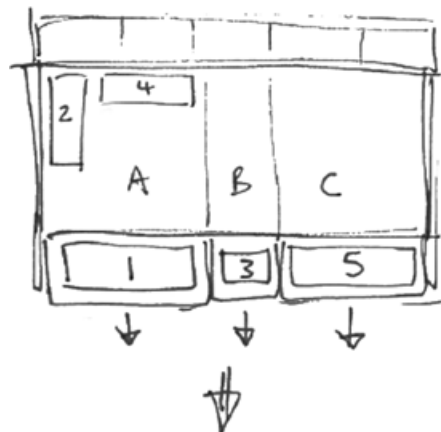
1.



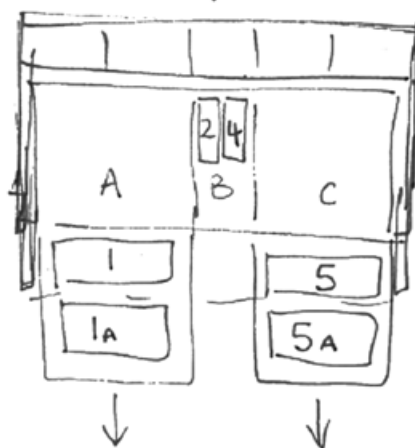
2.



3.



4.



#### Configurations:

1. Shelving + Couch or singlebed.
2. Shelving + Couch to 2 individual seats with fold down coffee table/ledge.
3. Shelving + Couch to Double bed.
4. Couch to 2 single beds (1A & 5A stored under couch) or 1 single bed + 1 individual seat.

Configurations for Bathroom & Kitchen

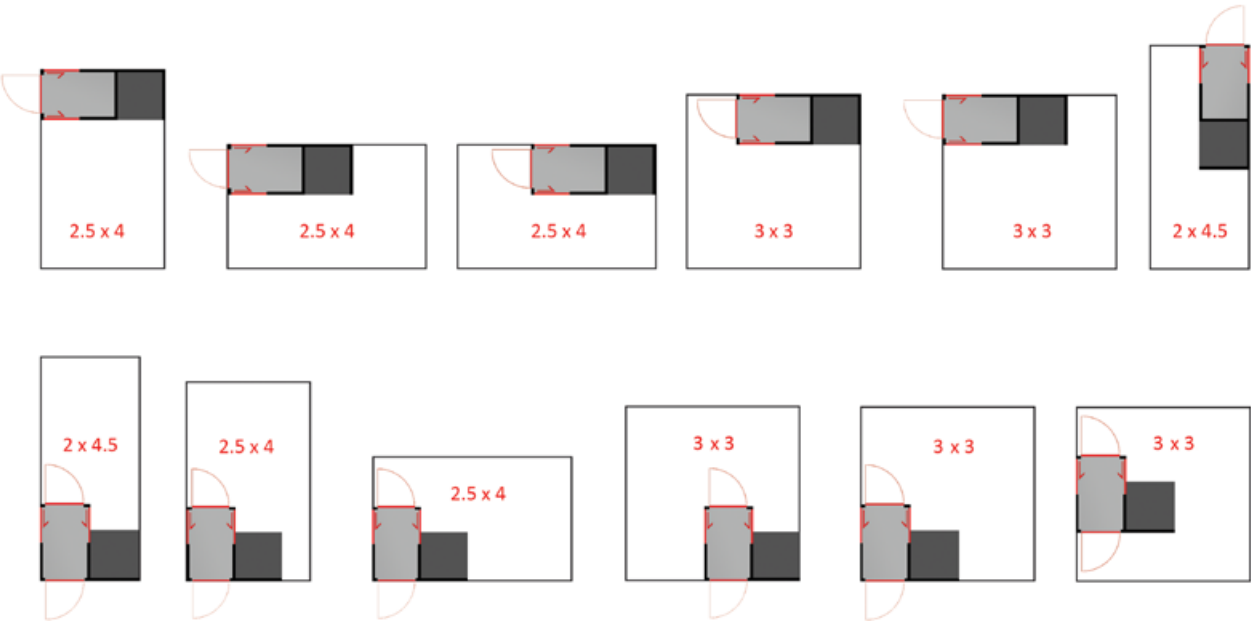


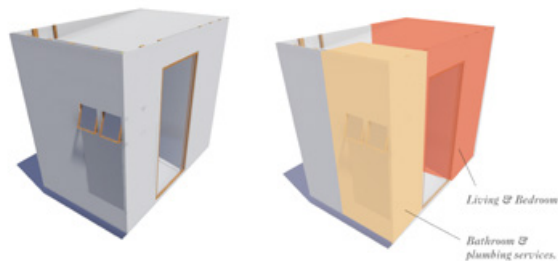
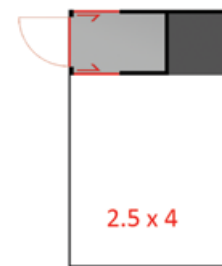
Figure. 4. 15. Layout configurations of bathroom & kitchen.  
Figure. 4. 16. (Opposite) Preferred layout concept, floor plan.  
Figure. 4. 17. (Opposite) Form and location of spaces.

Placing the 1.5m<sup>2</sup> bathroom space and 1m<sup>2</sup> kitchen space adjacent to one another means that each space can share the same services, reducing costs, materials and inconvenience in construction. Grouping the spaces together also creates a larger amount of left over space within the 10m<sup>2</sup> dwelling floor area, allowing more space for the bedroom/living area and open flexible space for the user to use however they may desire.

The image adjacent shows the selected most efficient floor plan layout in regard to the above points, but also for the ability to be repeated, both along the long and short sides of the plan. Another point to note is the variety of options for access to the bathroom, either internal or external.

Bathroom access variability in response to:

- Cultural preferences for the separation of hygiene activities with the preparation of food or areas of sleeping/praying/eating.
- Traditional approach to “the outhouse” seen in historic New Zealand baches.
- The need for more interior space, hence the desire or need to access the bathroom from the exterior.



## EXPLORING FORM

Having established the most efficient layout of space to be a rectangular floor plan measuring 4m x 2.5m, attention now shifts to the outer shell and overall aesthetic for the dwelling. Referencing literature and case study research, the exploration into form and shape focuses on mobility, adaptability, flexibility, scale, expansion and creativity.

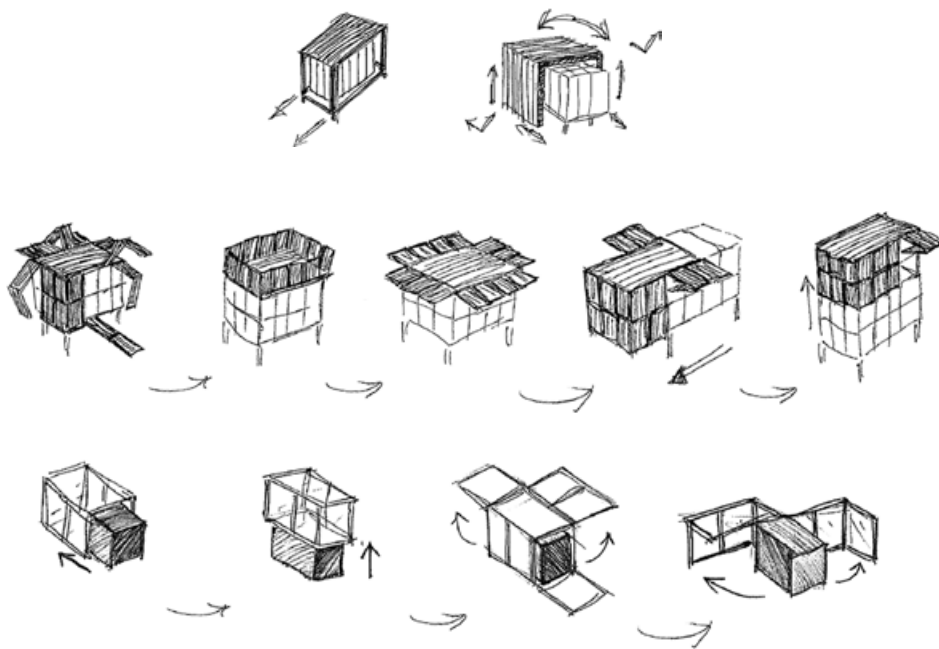
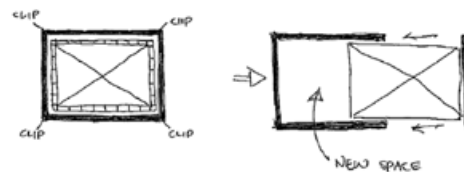
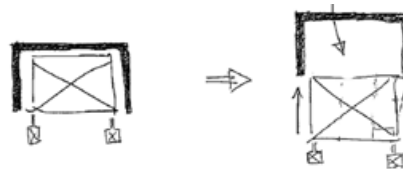


Figure 4. 18. (Above & Opposite) Form & adaptability exploration sketches.

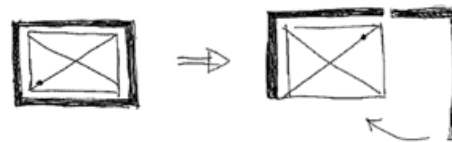
1. Slides  
*Plan view*



2. Raises  
*Elevation*

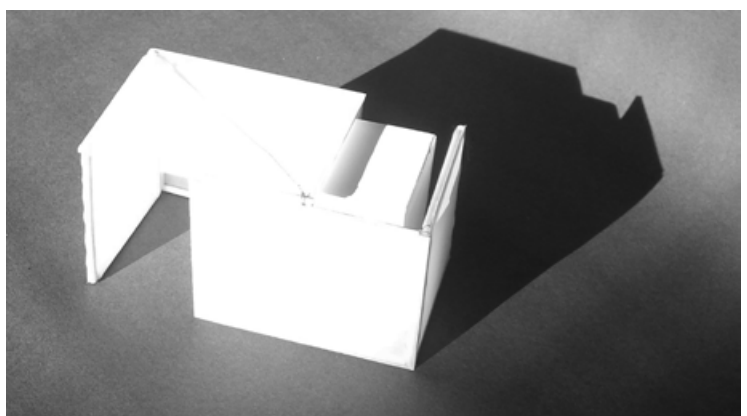
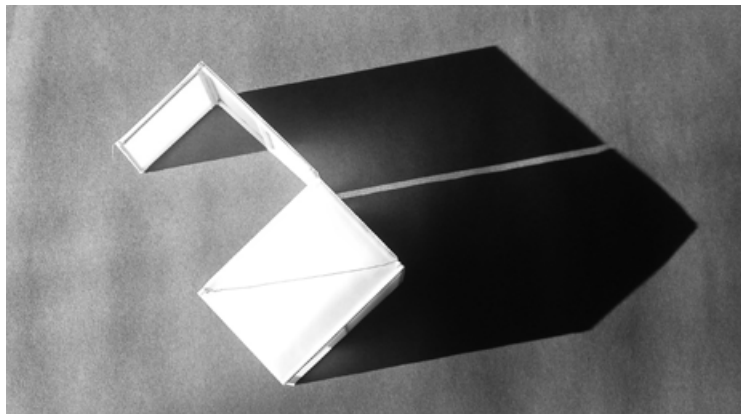
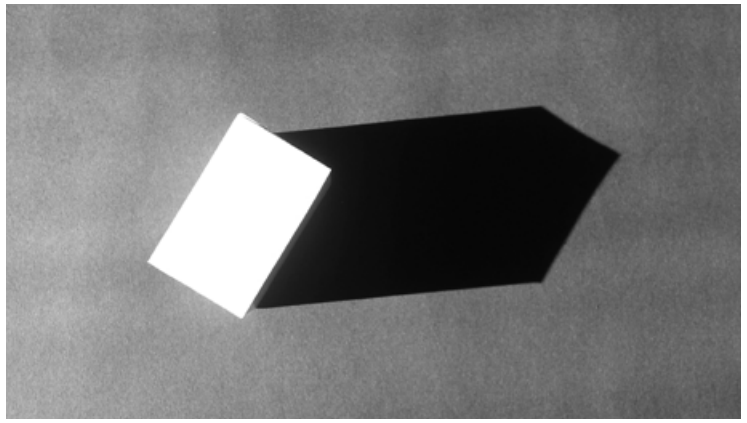


3. Pivots  
*Plan view*



4. Folds  
*Elevation*





*Figure. 4. 19. Structure & shell contained in 10m2.*

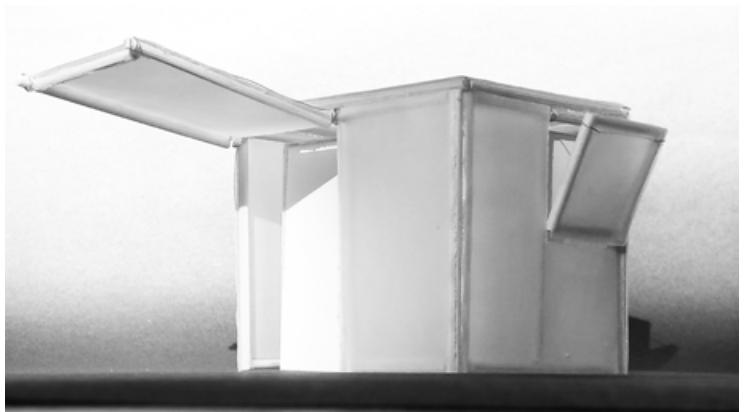
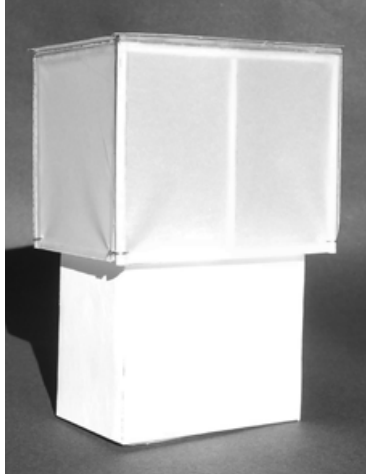
*Figure. 4. 20. Shell slides off structure, creating more space.*

*Figure. 4. 21. Side of shell opens to create sheltered space.*

*Figure. 4. 22. Part of shell slides to form extra space.*

*Figure. 4. 23. Both ends of the shell shift to reveal structure and create extra space.*

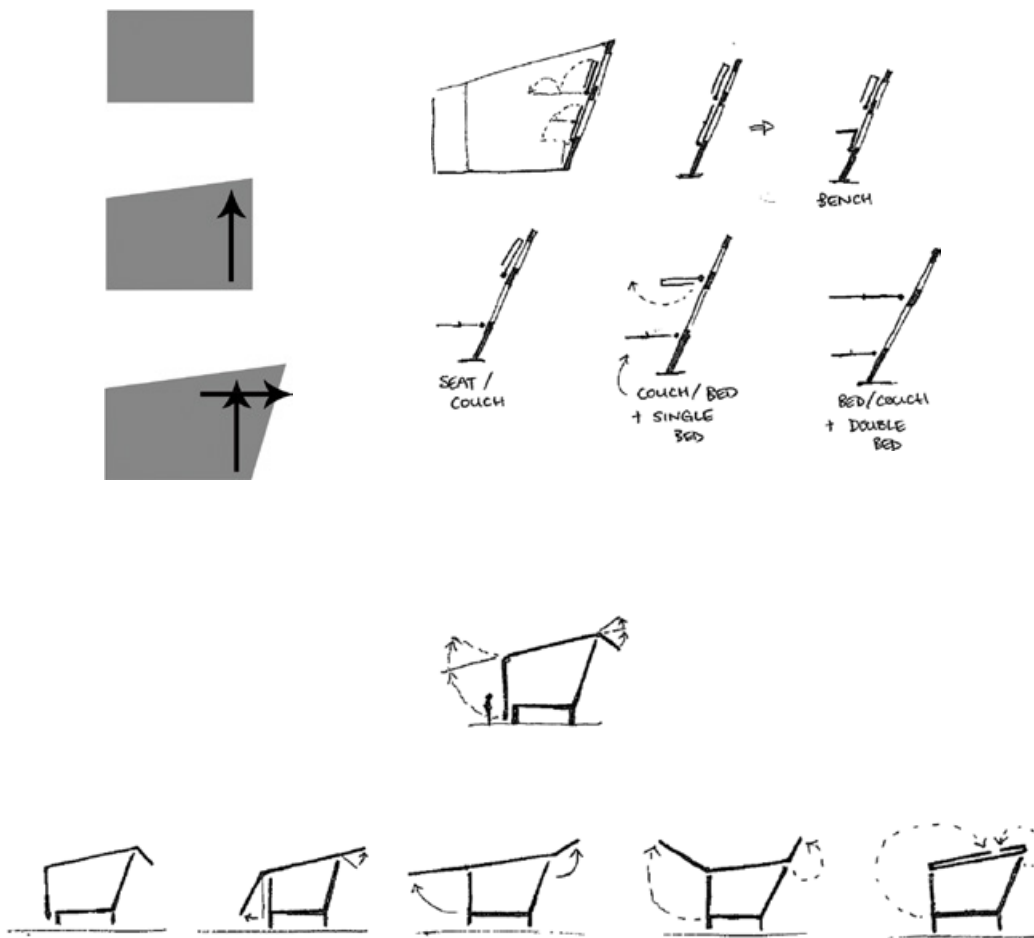




*Figure. 4. 24. Shell is elevated above structure, creating a second level.*

*Figure. 4. 25. Sections of the shell open and fold to reveal views to and from the internal structure.*

*Figure. 4. 26. Clustering multiple forms together to create a dynamic community and larger forms.*



### Roof Form:

Considering the maximum size for a dwelling not requiring a permit in New Zealand being 10m<sup>2</sup> in floor area, 3.5m stud height, with a maximum height off the ground of 1m, creative design is paramount to create a greater sense of space. By increasing the roof height at one end to the maximum 3.5m, a sloping roof form guides the eye upward and creates the illusion of more space. By also angling an end wall out with the same placement at floor level, the 10m<sup>2</sup> floor area is retained yet the vertical space is larger. The extra vertical space can be used for storage, sleeping and obtaining

more light/shade, without protruding into the valuable 10m<sup>2</sup> core space.

A dynamic roof or external cladding system that shifts and transforms can create more outdoor space, the potential for extending internal space and the possibility of connecting individual dwellings to one another. The shifting form also transforms the overall aesthetic, which can be tailored to the user's desires. Extra roof space can also be utilised for the collection of a greater amount of rainwater.

Figure. 4. 27. Diagram showing higher stud and angled form protruding out, creating more vertical space.

Figure. 4. 28. Sketches showing how an angled wall and roof can create better options for bed, bench and seat platforms.

Figure. 4. 29. Sketches showing a folding roof/cladding concept.

Figure. 4. 30. (Opposite) Image of timber material.

Figure. 4. 31. (Opposite) Image of aluminium material.

## Exploring Materiality

The two main materials considered for the design are timber and steel. These are selected due to the intended assembly method, where the user can assemble the dwelling themselves. For this to happen the building elements are to be easily connected and assembled without the need for alterations. Although steel is stronger than timber and can therefore be smaller in structural scale whilst spanning the same length as a larger timber member, the benefits of timber outweigh those of steel. Timber is selected as the main structural material due to its availability in most locations, its renewable nature and its aesthetic and textural properties. Timber can also be more easily adapted or altered, plus its lighter weight makes assembly easier for the user.

In regards to a New Zealand home, the final material selected for cladding is marine grade timber; referencing New Zealand's traditional Maori structures where timber was used due to its availability and ability to be easily crafted and manipulated. In later years, traditional New Zealand baches were also predominately clad with timber weatherboards or board and batten. Timber is also selected for the main cladding material due to its ability to expand and contract in varying seasons. In cooler winter months when there is more moisture in the air, timber will expand, sealing potential gaps and preventing unwanted drafts. In warmer summer months when the timber dries, it contracts, allowing more movement and airflow for better ventilation.

The selected interior cladding material, including floors and ceiling, is also timber, continuing the aesthetic from the exterior

to the interior. This choice creates a more streamlined and consistent aesthetic. Due to the small scale of the dwelling, material types are best kept to a minimum, as using a large range of different materials would appear cluttered. Treatment of timber, i.e. stain or paint, can be determined by the user, dependant on taste, affordability and stage in life, i.e. later in life a user may desire a different aesthetic so can alter the colour or treatment of the timber.

Wet areas such as the bathroom and kitchen cube remain timber however are marine grade and treated with a waterproof final layer to prevent the timber rotting and to prolong the life of the material. The bathroom floor panel incorporates slots between each floor board, allowing water to pass through the floor boards and be collected in an aluminium tray attached to the floor panel beneath. Fixtures such as taps, sinks and the shower are likely to be stainless steel, however can be selected by the user according to their preferences.

Structural elements including the adjustable foundation system, bracing and fixings are aluminium. This is the most suitable material for these elements due to its light weight and high strength ratio plus its inability to rust as steel or iron would.

The possibility for material variations not only concerns the New Zealand context, but also for the adaption to other cultures, contexts and local vernacular design. Because timber is the most widely available material around the world, it is the most suitable material selection to ensure adaptability and flexibility in use.



## Connection

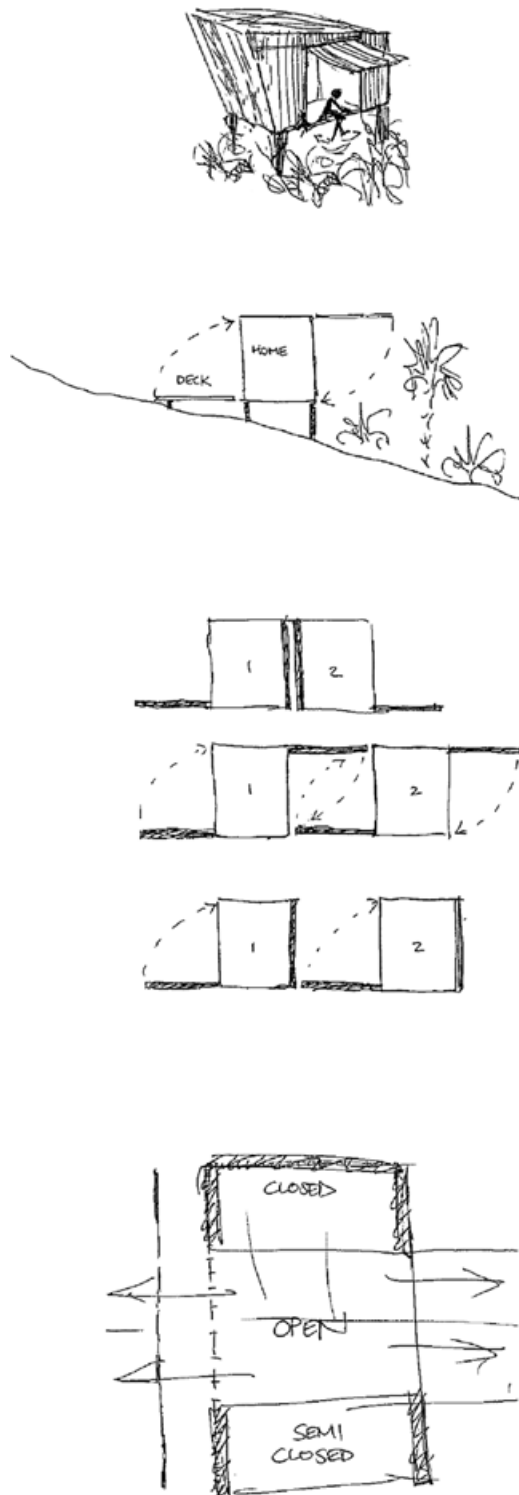
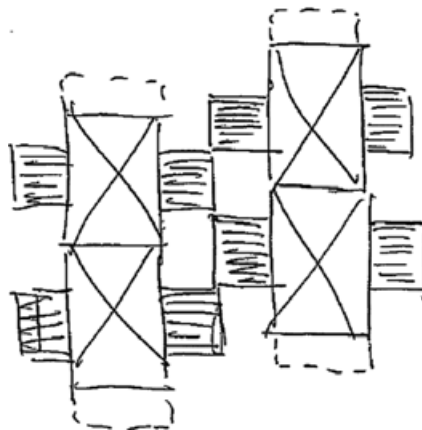
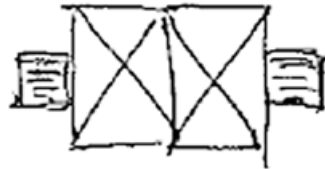
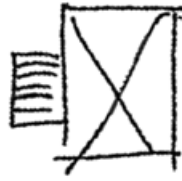


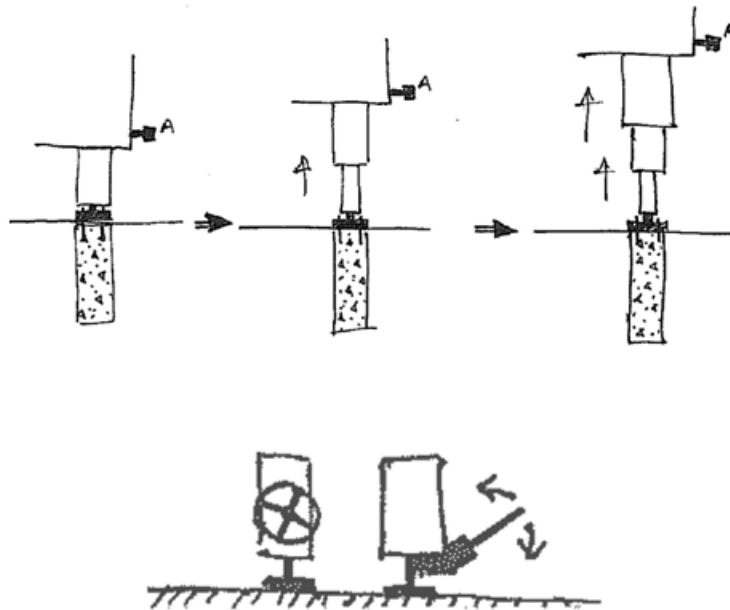
Figure. 4. 32. Sketches of opening sides on dwelling, connecting to other dwellings.

Figure. 4. 33. (Opposite) Sketches showing different configurations and connections to one another:



Opening sides allows the dwellings to connect to each other easily, creating an open and flexible central space, responding to the shared living spaces and desire for co-living amongst New Zealand's Maori and Pacific cultures in particular. When connected in a group, the dwellings are also suited to student housing or a traditional New Zealand bach community. The dwellings can also take on new uses such as community facilities, work spaces or a resort. Depending on the way each dwelling is connected to the next, different levels of privacy can be achieved.

## Exploring Structure



Adjustable foundations concept:

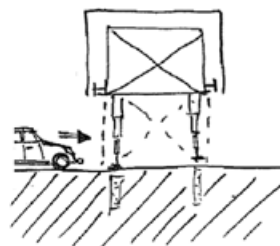
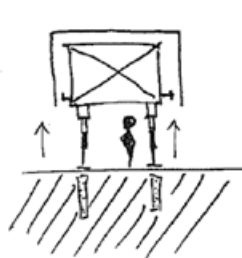
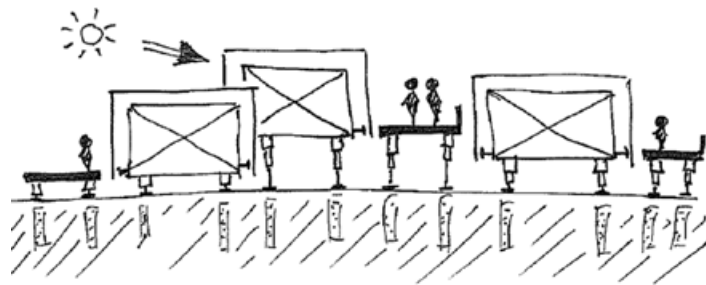
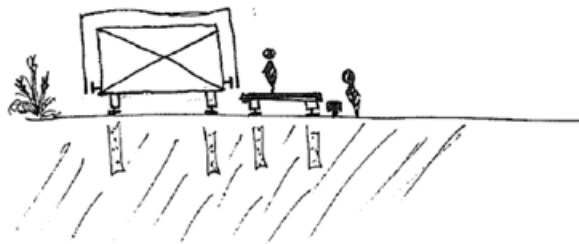
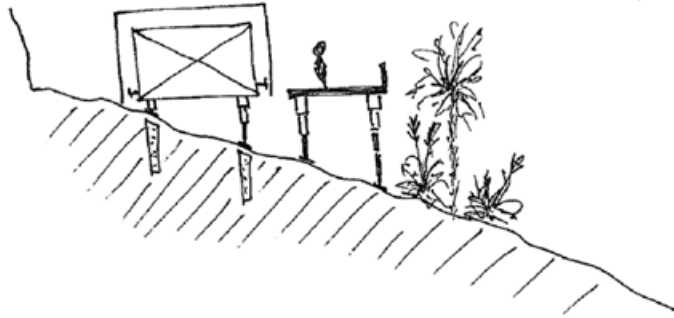
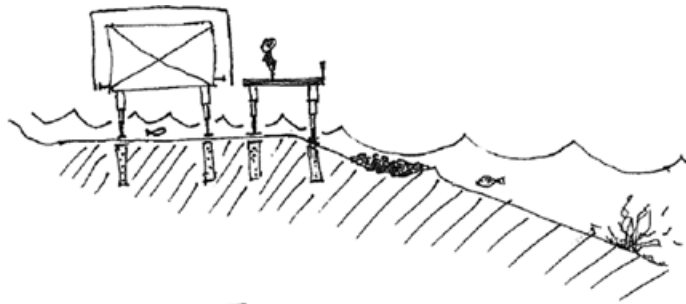
- Can be raised in the event of a flood.
- Can be altered according to site topography, i.e. can sit level on a steep sloping site.
- Can sit level and low to the ground for ease of access on a flat site.
- When clustered in a community, the dwellings can sit at different heights to allow for more privacy, better views, security and more/less sunlight.
- Can be raised to create an extra level for living, entertaining, storage or parking.
- Minimal ground footprint and damage to site.



Figure 4. 34. Adjustable foundations sketches.

Figure 4. 35. Key characteristics informed by case study analysis.

Figure 4. 36. (Opposite) Sketch of adjustable foundations scheme and various applications.



## Intended Method of Use

### *The Stepping Stone Concept:*



#### *Stage 1: YOUTH*

- Borrow a small area of land (with an already existing primary dwelling) from parents, friends or family member's property.
- Obtain a personal bank loan or loan from family to cover the costs of building the 10m<sup>2</sup> dwelling.
- Assuming the dwelling can be built for an all inclusive cost of under \$20,000 the loan can be paid off within two years (based on low New Zealand wage income), leaving the young person free from rental and mortgage costs.

#### *Stage 2: ADULT*

- Without rent or a mortgage, the young adult is in a better position to save for the deposit/purchase of land of their own, plus any extra costs for permits and consents.
- Eliminating rent/mortgage gives the young adult the option to save more money for other experiences such as travelling, or to cover the costs for expansion of the initial dwelling responding to the users changing needs, i.e. marriage & children.

#### *Stage 3: MIDDLE AGED*

- At peak of life and top of Maslow's hierarchy of needs; self-actualisation and achieving full potential.
- Further expansion of the dwelling in response to changing needs and desires, such as a growing family or desire for comfort.
- Total ownership of land and dwelling.

#### *Stage 4: RETIRED - ELDERLY*

- Total ownership of land and dwelling gives the now elderly user freedom to travel or enhance the dwelling responding to changing needs such as access to services and amenities.
- Reduction in scale due to family members having moved out and changing outlooks on life (usually less materialistic), therefore components added over the years can be removed and either sold or gifted to children, ready to begin the cycle again.



This cycle removes the disposable nature of house buying and selling and frees people from the burden of mortgage liabilities and rents. The concept suggests that the dwelling remains with the user throughout their lifetime, adapting to changing needs and specific situations. Aside from being a singular concept, multiple dwellings can be connected in order for family members and different generations to live together if desired.

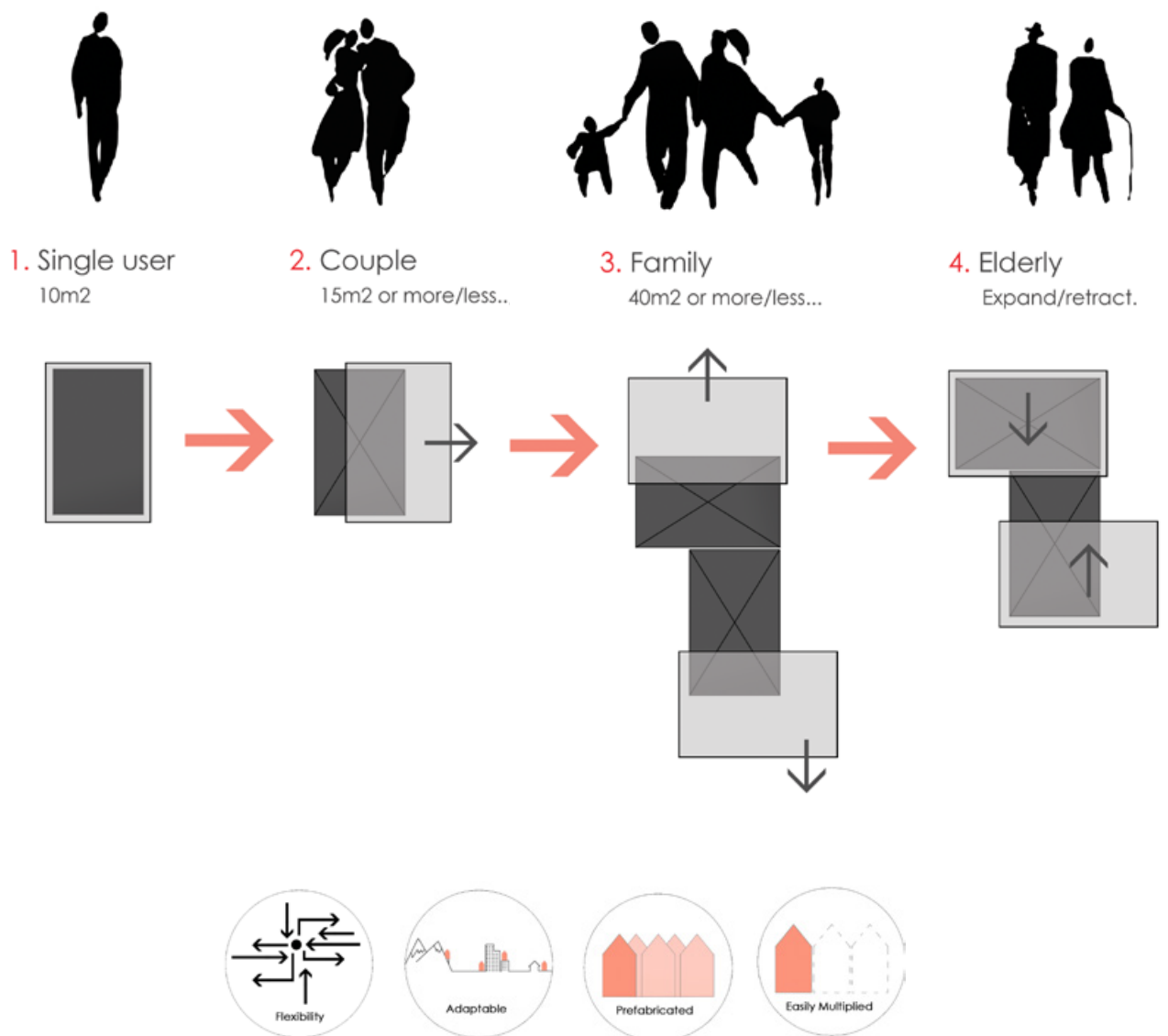


Figure. 4. 37. (Opposite) Stepping stones - concept.

Figure. 4. 38. Diagrams showing progression through each stage and what each may look like.

Figure. 4. 39. Key characteristics informed by case study analysis.



- STAGE 1 - Single dwelling **10m2**  
A basic, cost efficient dwelling on borrowed land, enabling young people to own their own home.



- STAGE 2 - Two+ dwellings **20m2+**  
As young dwellers save money and needs change, a second dwelling can be added, along with more luxuries the potential for their own site.



Figure. 4. 40. Render of singular concept.

Figure. 4. 41. Interior render of singular concept.

Figure. 4. 42. Render of stage two concept.

Figure. 4. 43. Interior render of stage two concept.

- STAGE 3 - Expansion **50m2+-**

As families grow, there is a need for more space. Multiplication of dwellings and more luxuries can be added.



- STAGE 4 - Reduction **30m2 +-**

As the owners age and children leave home, less space is required. A reduced scale allows for other desires to be obtained, such as a new interior aesthetic.



Figure. 4. 44. Render of stage three concept.

Figure. 4. 45. Interior render of stage three concept.

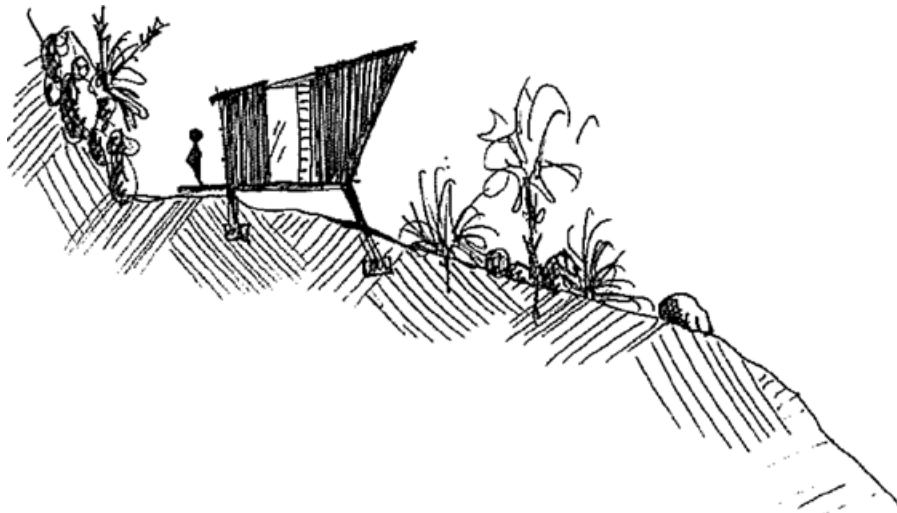
Figure. 4. 46. Render of stage four concept.

Figure. 4. 47. Interior render of stage four concept.



# 5

CHAPTER FIVE  
FINAL DESIGN



*Figure. 5. 01. Design concept sketch.*



## Final Design Proposal

Living with less, both materially and spatially is a way young people can save money and obtain home ownership, however the idea of living a more refined lifestyle is an attitude that the user must be willing to cultivate, as many people require excessive amounts of material possessions and space to feel fulfilled or successful. Therefore the proposed housing model will not be desirable for all users, but for those who seek an alternative way of living in order to obtain a home of their own and the financial freedoms it enables.



*Figure. 5. 02. Render showing veranda/shelter – creates extra flexible space; a threshold space: out of the rain, a place to enter/exit/greet/farewell, offers protection, offers prospect, and connection.*

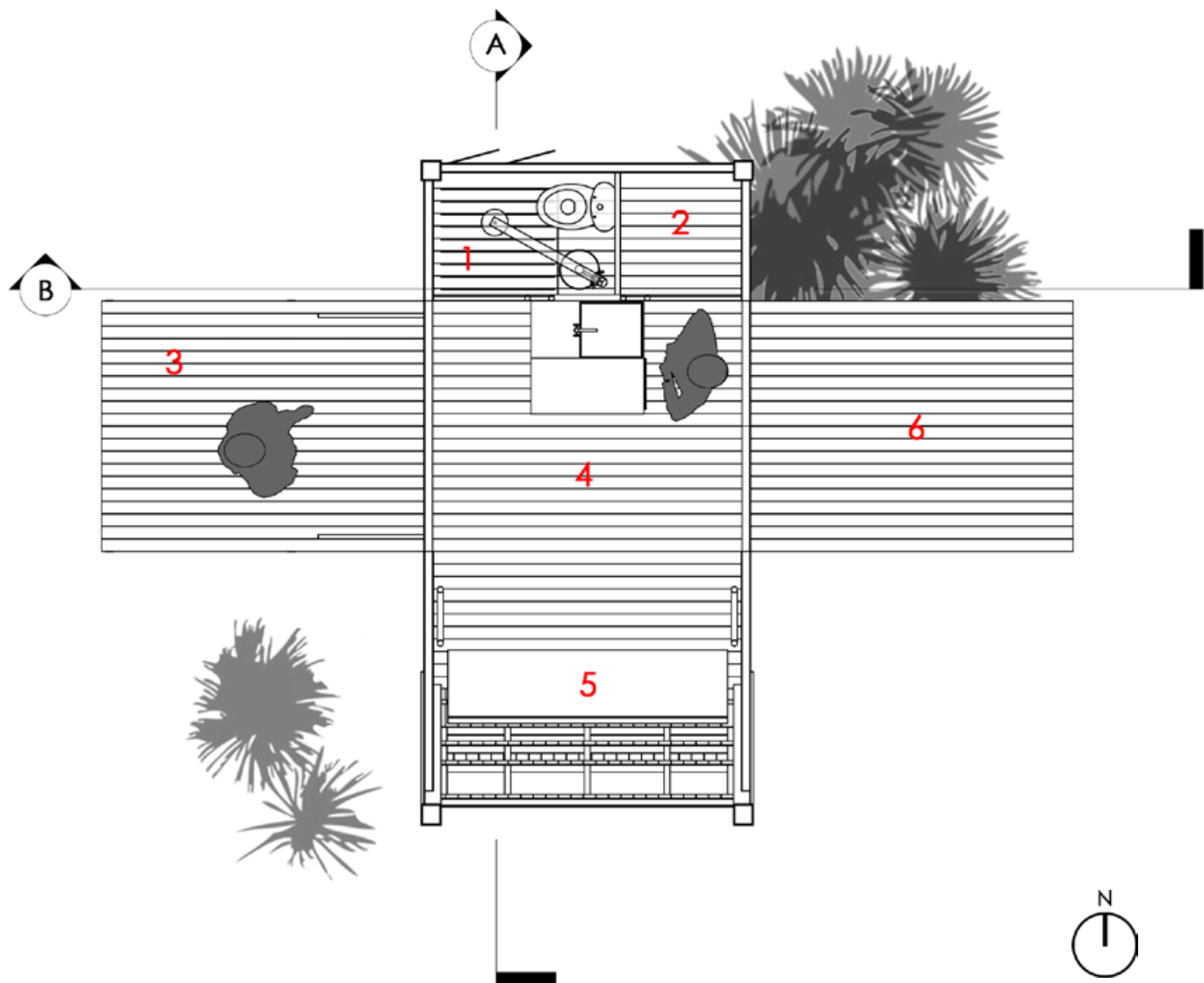


The positive aspects of living in the small, multi-functional space, as seen also in Miljutin's living cell and traditional New Zealand bachs, is that costs are reduced, there is less maintenance needed, less impact to the environment and the specific site. Users are also better connected to one another and to their surroundings when in smaller open spaces, than they would be when separated by individual rooms.

The main characteristic of the design is its ability to be taken through life, adapting to the changing situations and environments that the user may place it in.



*Figure. 5. 03. Render of singular dwelling concept from opposite side showing deck space.*



*Ground Floor Plan  
1:50*

1. Bathroom
2. Cupboard & Kitchen store space
3. Deck
4. Open & flexible floor space
5. Folding bench/couch/bed
6. Folding roof/shelter

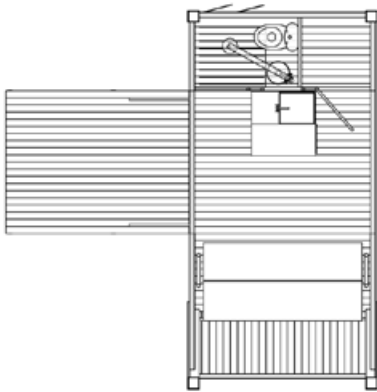
*Figure. 5. 04. Floor plan of singular dwelling.*

*Figure. 5. 05. (Opposite) Floor plans showing different configurations and ways to use the space.*

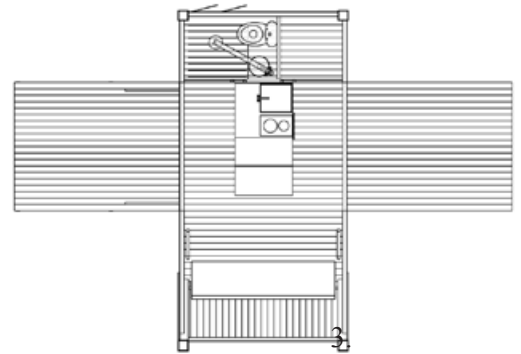




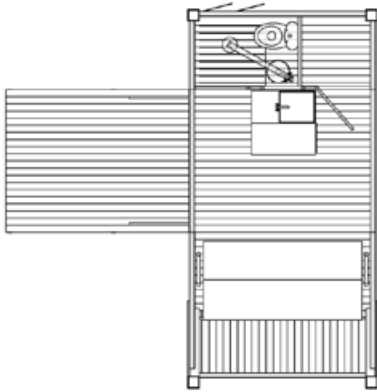
1.  
1:100



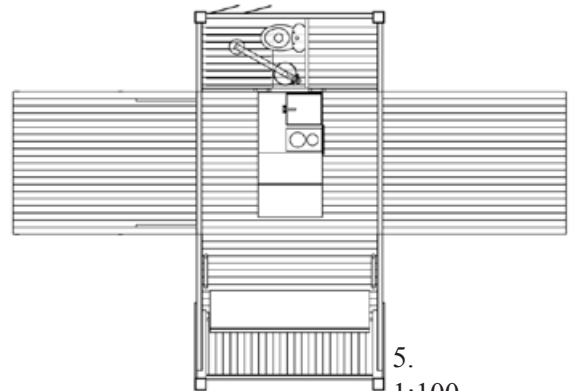
2.  
1:100



3.  
1:100



4.  
1:100



5.  
1:100

- Layout options:
- 1. Closed & contained plan & elements.
- 2. Deck space folded down, kitchen in place allowing storage cupboard free for use, couch platform folded down for use.
- 3. Kitchen cube expanded, shelter side panel open & folding platform in use as a bench/desk.
- 4. Kitchen fully expanded, folding platforms folded away, side panels open.
- 5. Kitchen cube wheeled onto deck for outdoor entertaining, folding platform set up as desk.



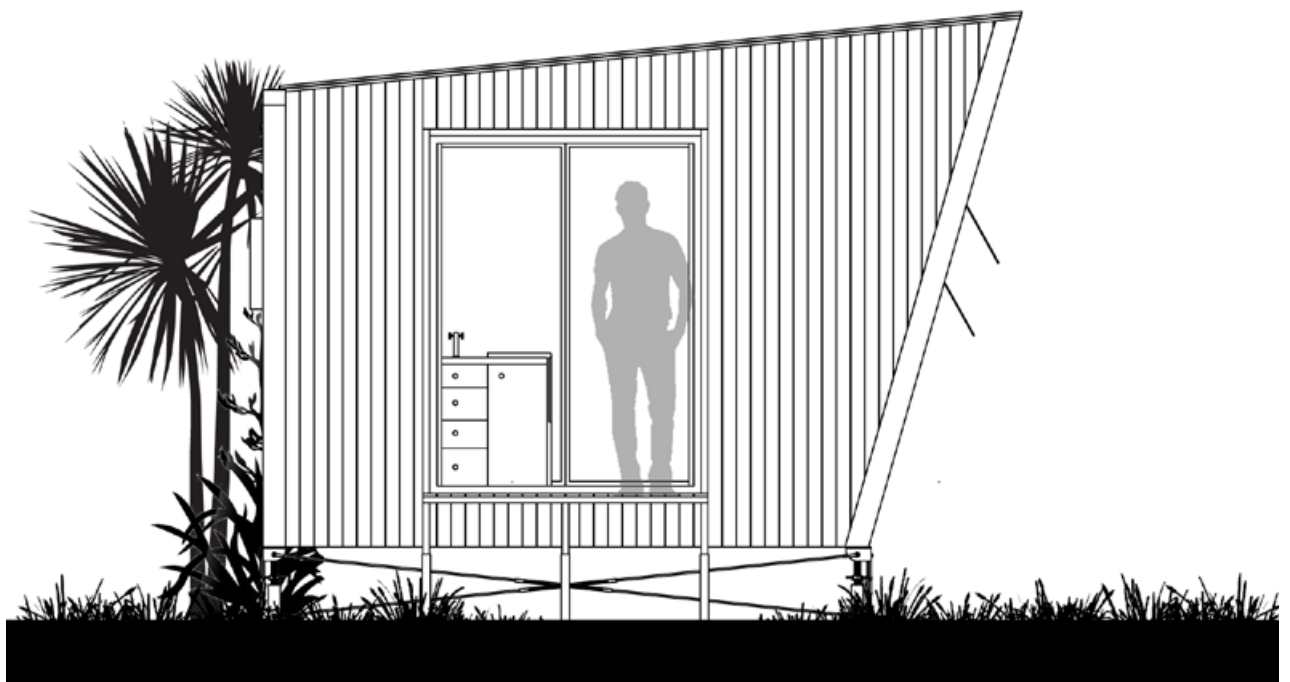
*Figure. 5. 06. North Elevation at 1:50*



*Figure. 5. 07. South Elevation at 1:50*



*Figure. 5. 08. East Elevation at 1:50*



*Figure. 5. 09. West Elevation at 1:50*

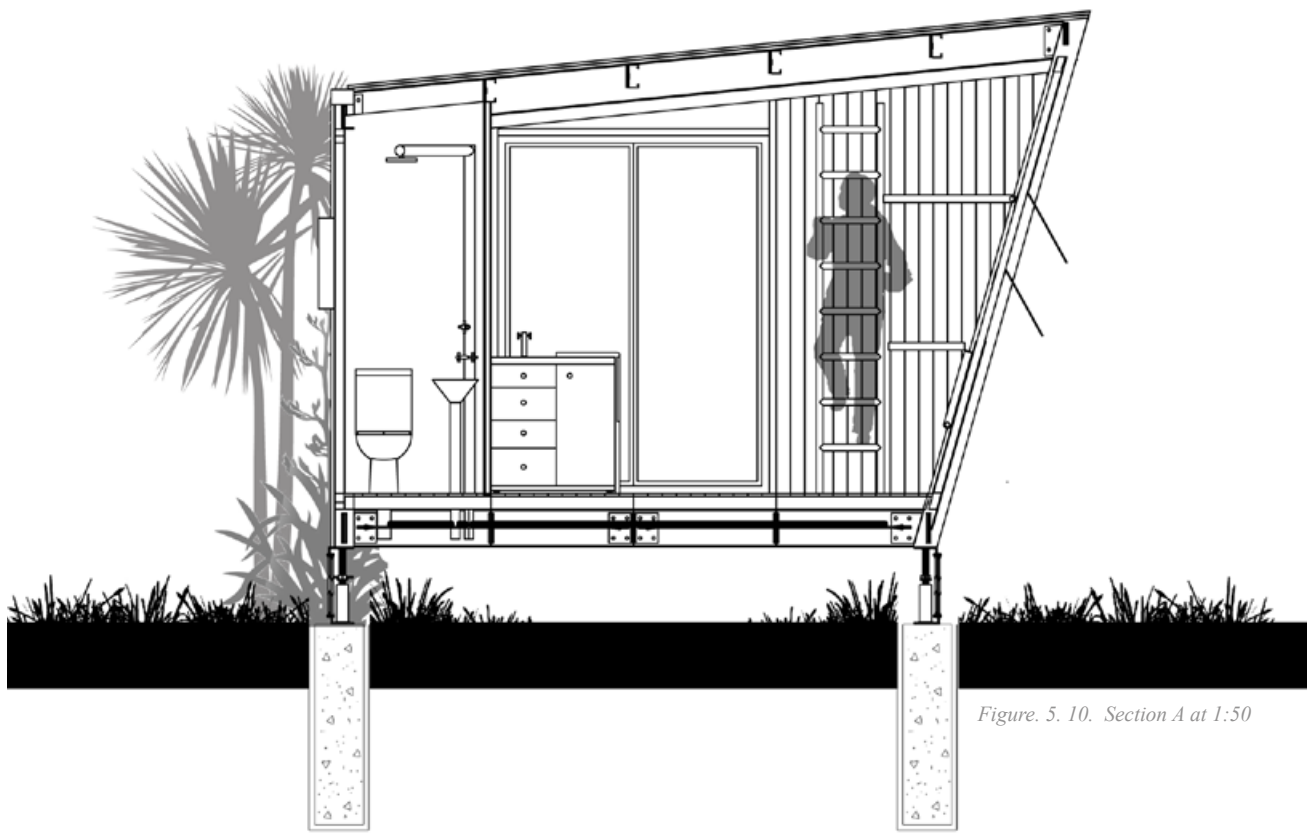


Figure 5.10. Section A at 1:50

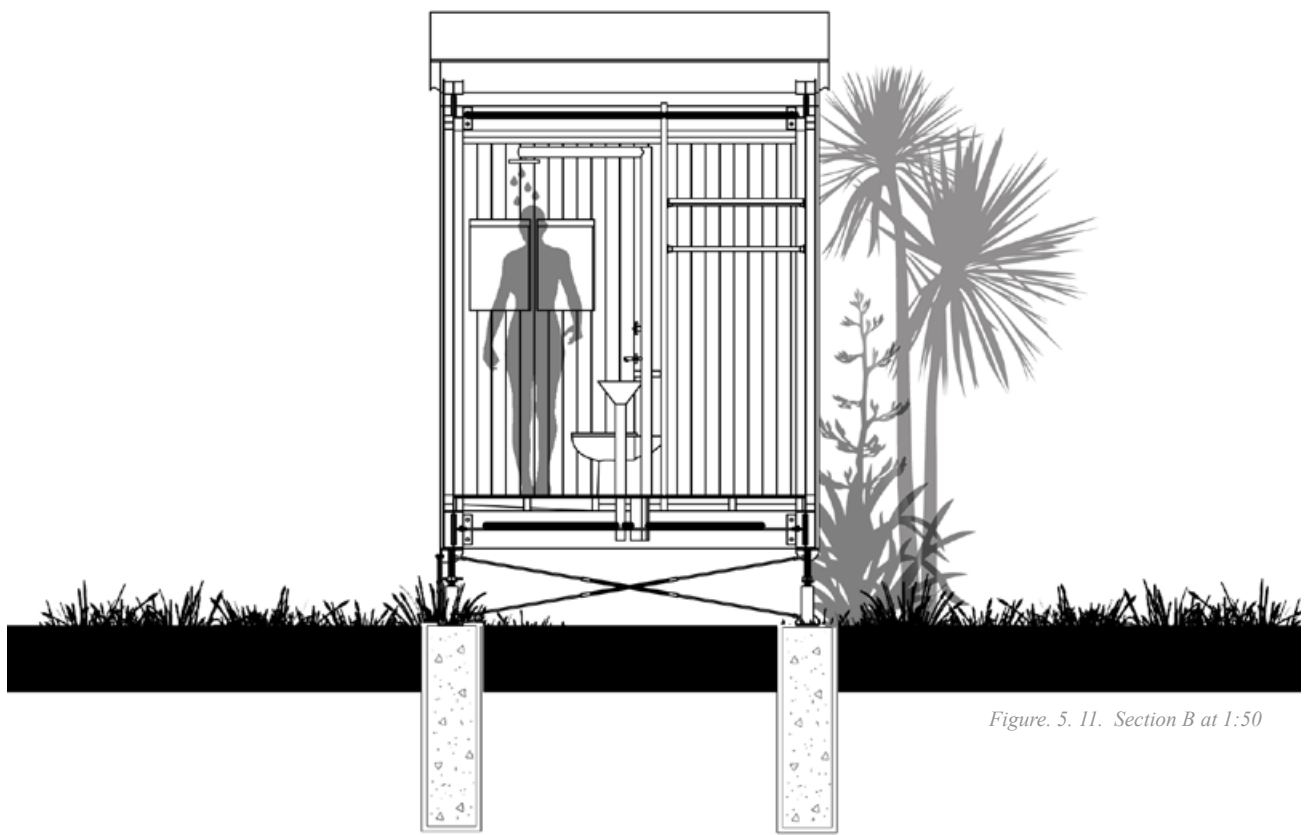


Figure 5. 11, Section B at 1:50

## Kitchen Cube

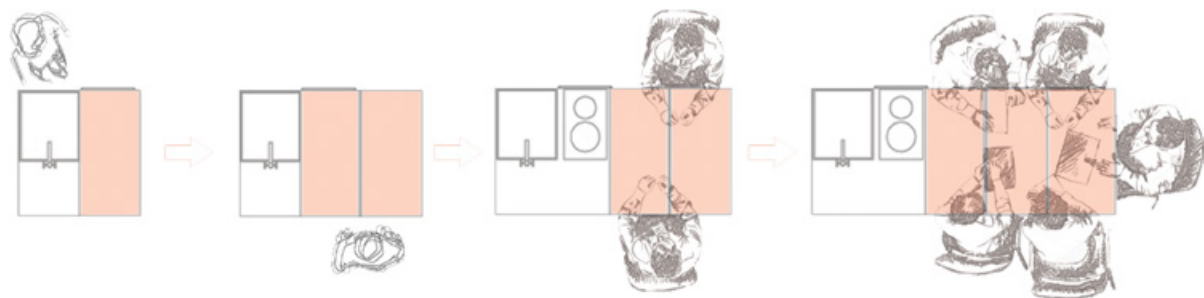
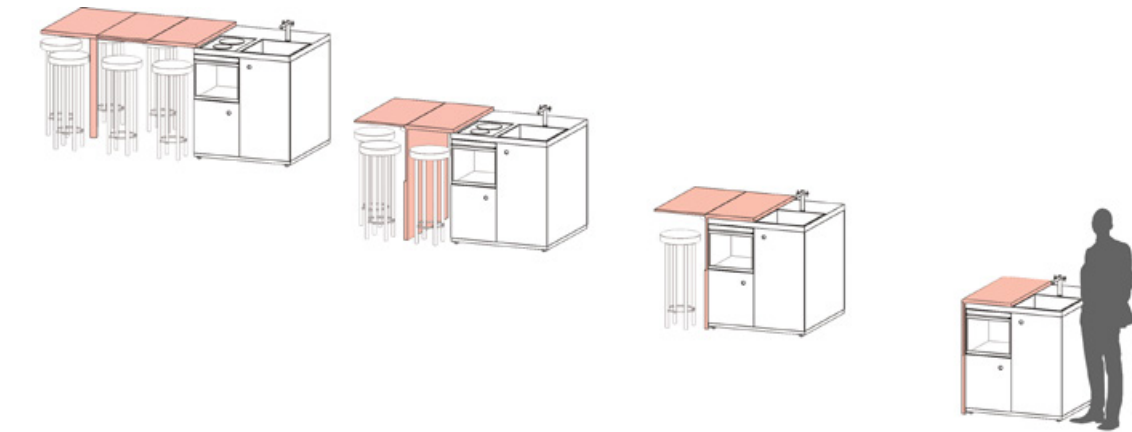
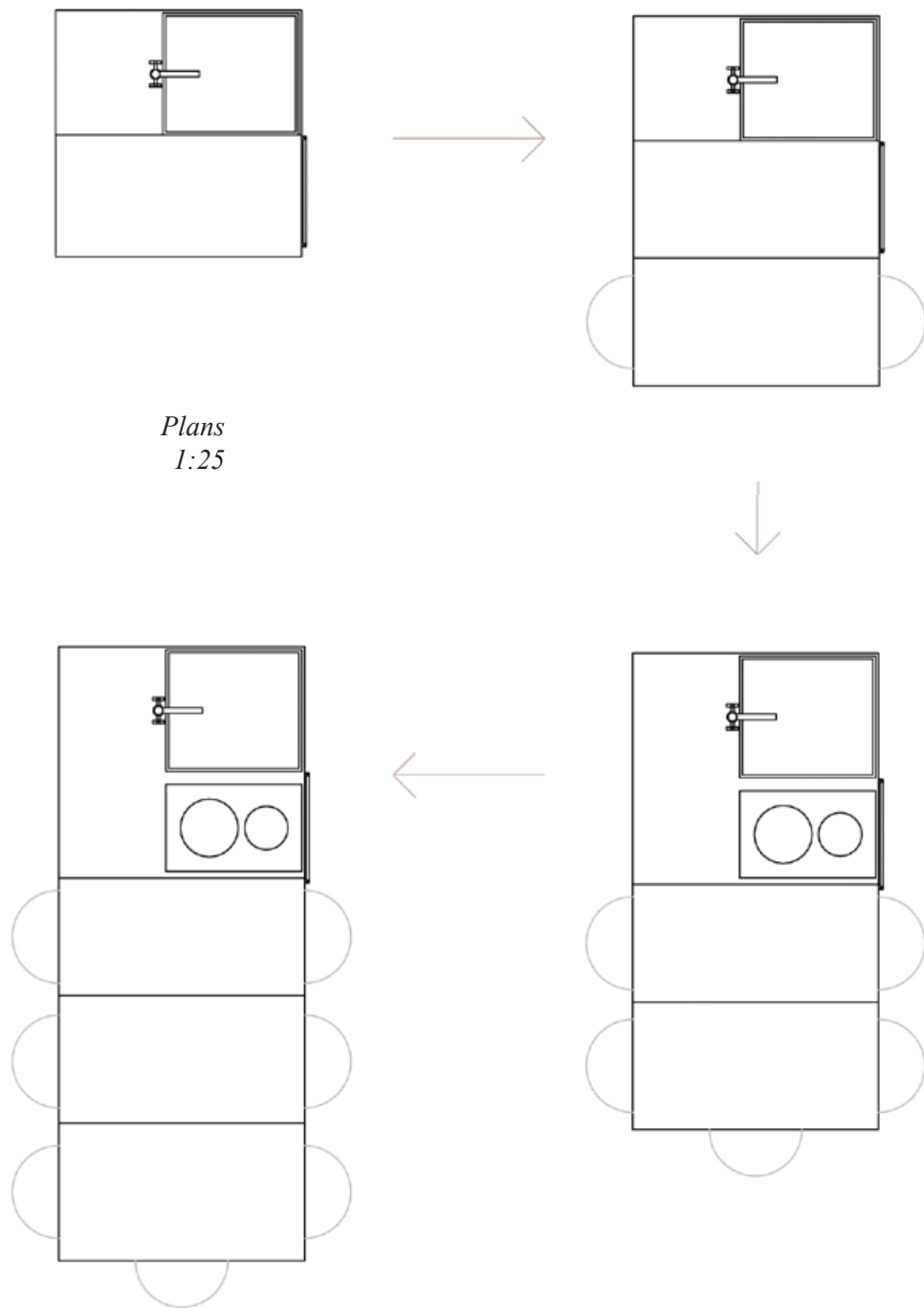


Figure 5. 12. 1m<sup>2</sup> area for kitchen space.

Figure 5. 13. Perspective, elevation and plan of kitchen cube and various configurations.

Figure 5. 14. (Opposite) Scaled plans of kitchen cube at 1:25



*Plans  
1:25*

The final kitchen design measures 0.9m<sup>3</sup> in its contained state. The ability for the kitchen to expand makes it flexible for many uses, such as a small kitchen, a kitchen with larger bench space, a kitchen and dining space or a work/office space. The design is completely mobile, with six castors beneath allowing the kitchen to be rolled around the space freely or out onto the deck for entertaining. Services are connected via flexible pipes/hoses connecting to ground pipes. Each hose can be moved to various locations where the kitchen and bathroom may be located and connected through openings in the floor at fixed points.

## Bathroom

1.5m<sup>2</sup>

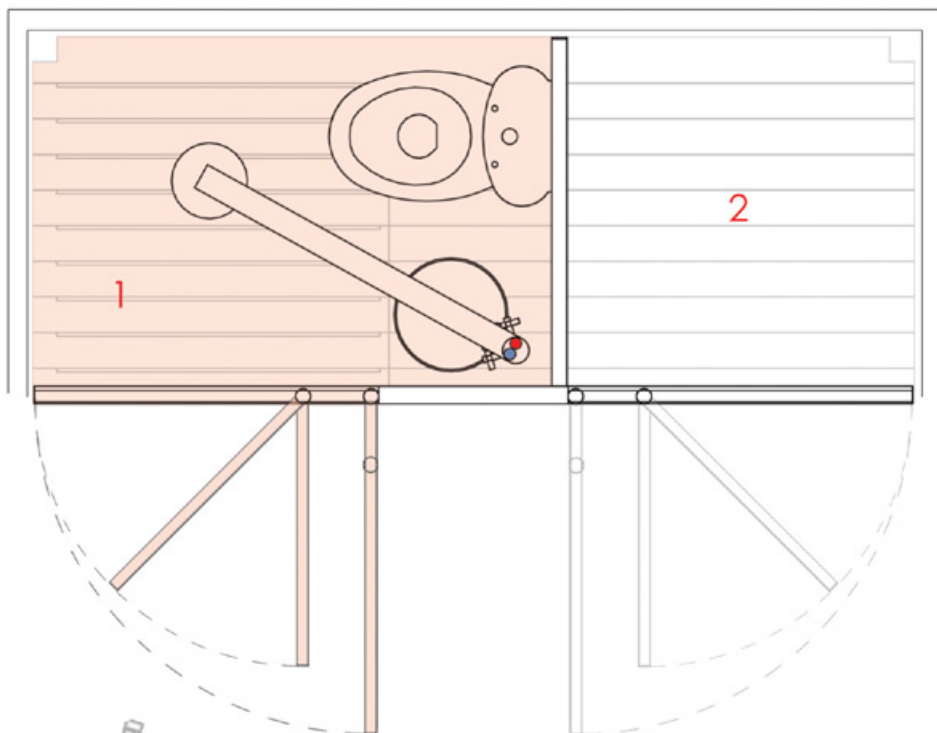


Figure. 5. 15. 1.5m<sup>2</sup> space for bathroom.

Figure. 5. 16. Plan of bathroom space at 1:20



1. 1.5m<sup>2</sup> bathroom space with flexible door for ease of use and adaptability.
2. Storage cupboard and space to store 1m<sup>2</sup> kitchen when not in use. The bathroom can also be extended into this space if a larger bathroom is desired. The storage space can also be removed to provide a connection to a second dwelling when placed back to back.



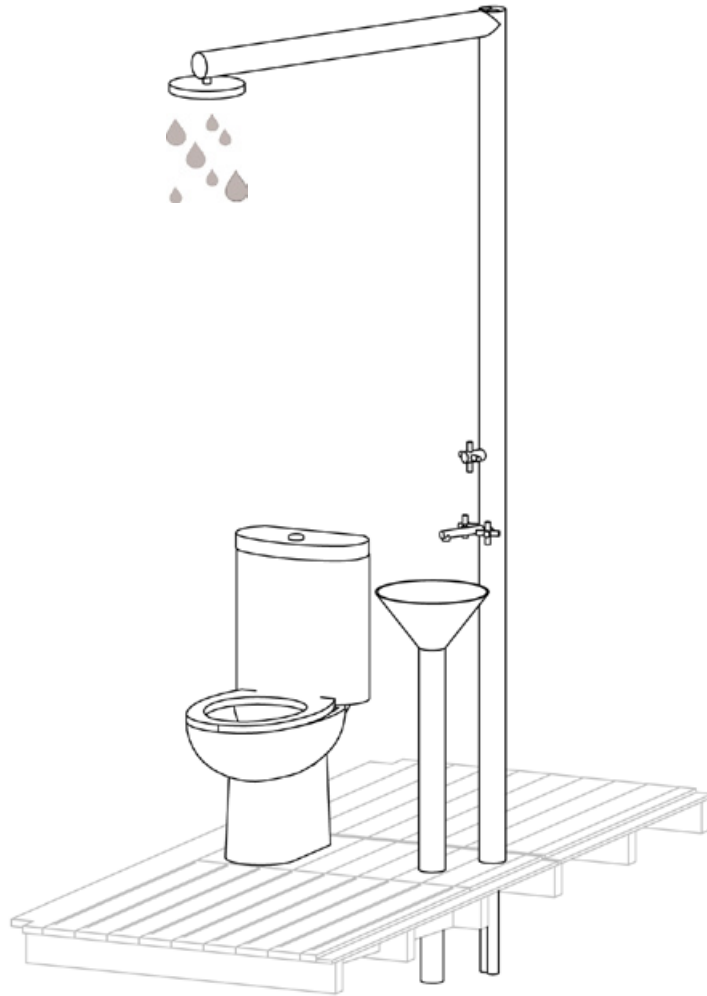


Figure. 5. 17. Perspective of bathroom space at 1:20

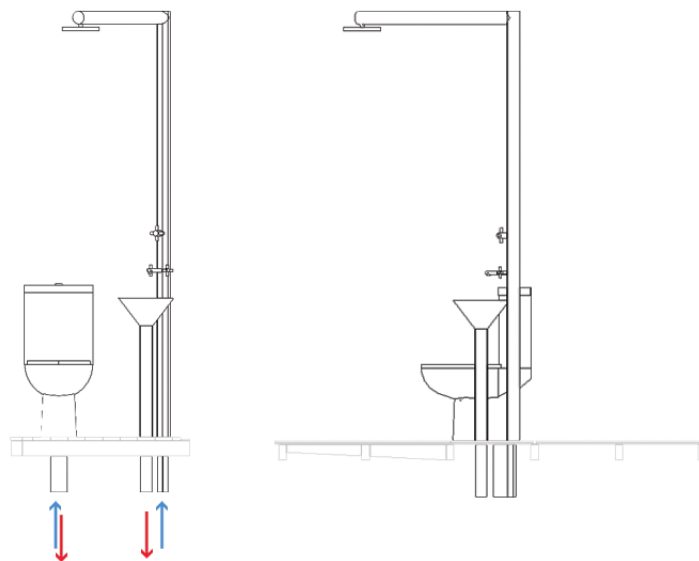
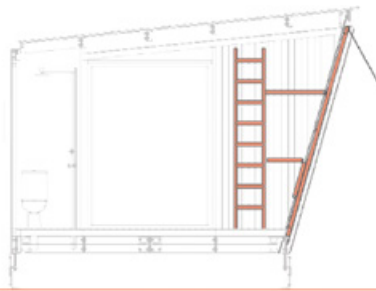


Figure. 5. 18. Elevations of bathroom space.

## Bedroom & Living

2m<sup>2</sup>



Upper bunk bed with  
lower couch or bed.

Upper bunk bed with  
lower bench or desk.

Folded bunk bed with  
folded couch/ bed



The living and bedroom space is flexible for many uses. The lower platform can be folded down and used as a couch or sleeping area. A mattress/cushions can be added for comfort and stored in the storage cupboard when not needed. This platform can also be folded up to a bench as an extension of the kitchen/dining, used as a desk or folded away completely for extra floor space. The upper platform can be used for storage or as a second bed for guests, with access via ladder at either end. The second ladder can also be unclipped from the wall and utilised as a rail for the upper bunk, which is supported by thin cables at each end. The lower bunk/seat/bench is also supported in the same way.

*Figure. 5. 19. (Opposite) 2m<sup>2</sup> space for bedroom & living.*

*Figure. 5. 20. (Opposite) Long section with living & bedroom space highlighted.*

*Figure. 5. 21. (Opposite) Configurations of bedroom and living space.*

*Figure. 5. 22. (Above) Render showing living space with bunk bed and couch.*



Figure. 5. 23. Render showing the interior of the AdAPTA-Home.





Figure. 5. 24. Render showing the exterior of the AdAPTA-Home.

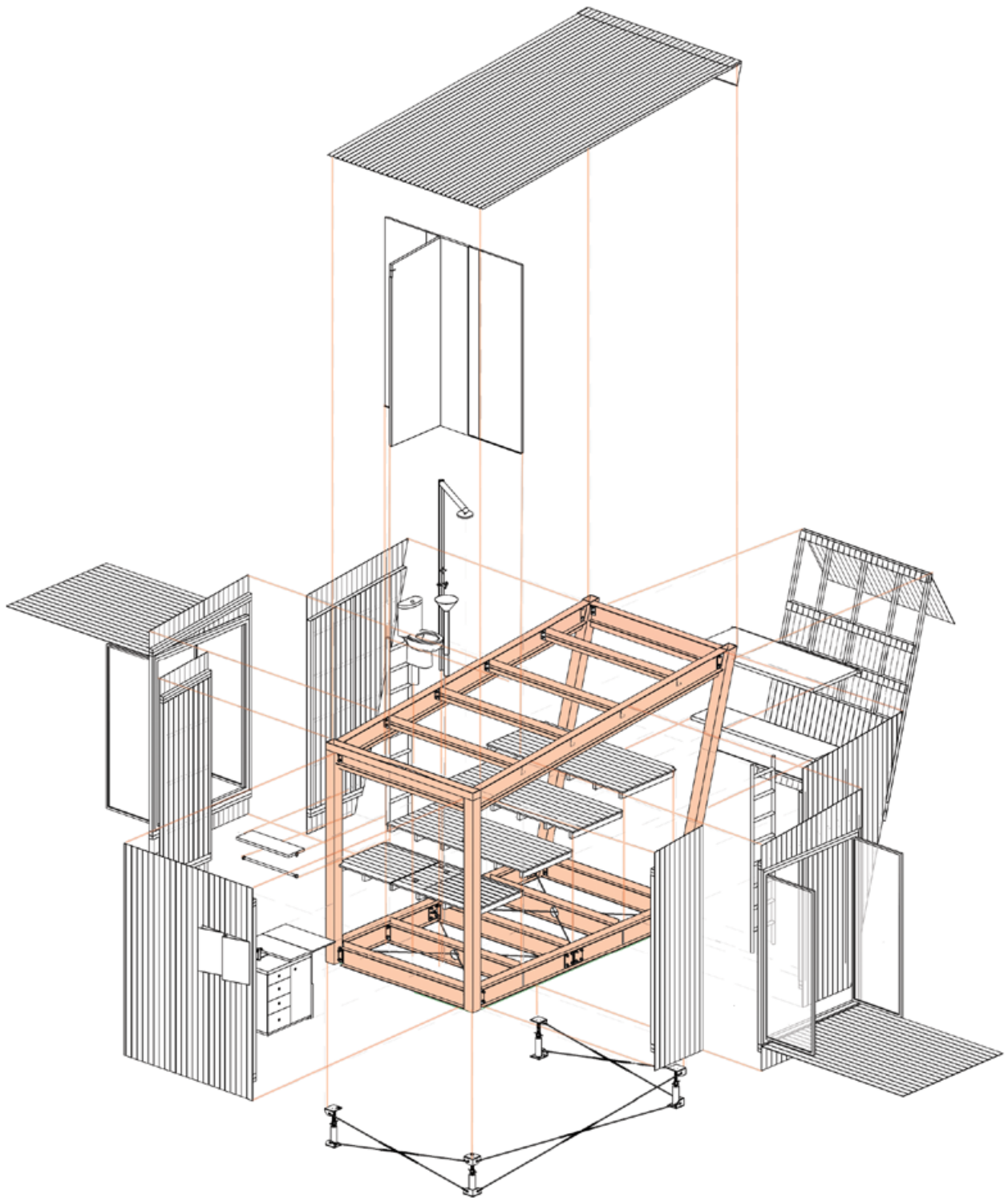


Figure. 5. 25. Exploded perspective view of design, showing primary structure with cladding sections, components and foundations.

Figure. 5. 26. (Opposite) Table showing cost breakdown and rough estimates of prices.

## Cost & Component Breakdown

	<i>Item</i>	<i>Quantity</i>	<i>Total Size of all items (m3)</i>	<i>Cost per item</i>	<i>Total cost</i>
<b>Roof</b>					
	Long run iron roof sheets (includes screws)	13.5		\$25.00	\$337.50
	Aluminium Flashing (Custom)	1		\$50.00	\$50.00
	Gutter (custom)	1		\$100.00	\$100.00
<b>Primary Structure</b>					
	Timber Hollow Box Sections	2		\$300.00	\$600.00
	Angled timber hollow box sections	2		\$350.00	\$700.00
	Timber I-beams with lip (Straight)	2		\$400.00	\$800.00
	Timber I-beams with lip (Angled)	2		\$500.00	\$1,000.00
	Short Timber I-beams with lip (Floor)	5		\$250.00	\$1,250.00
	Short Timber I-beams with lip (Roof ends)	2		\$250.00	\$500.00
	Aluminium Purlins (Roof)	4		\$45.00	\$180.00
	Roof brackets	16		\$20.00	\$320.00
	Floor brackets	18		\$35.00	\$630.00
	Bolts (With washers and nuts)	84		\$5.00	\$420.00
	Screw jacks (Foundations - steel)	4		\$150.00	\$600.00
	Bracing (Foundations - steel rod & coupling combo)	6		\$150.00	\$900.00
	Bracing (Floor - steel rod and coupling combo)	4		\$150.00	\$600.00
<b>Secondary structure</b>					
	Floor panels (Timber flooring with joists)	4		\$150.00	\$600.00
	Bathroom end wall panel (Framing and cladding)	1		\$450.00	\$450.00
	Angled end wall panel (Faming and cladding)	1		\$500.00	\$500.00
	Small side wall panel (Frame and cladding)	2		\$200.00	\$400.00
	Large angled side wall panel (Frame and cladding)	2		\$350.00	\$700.00
	French door panel with deck (Frame, cladding and doors)	1		\$550.00	\$550.00
	French door panel with roof/shelter (frame, cladding and doors)	1		\$550.00	\$550.00
	Folding deck foundation system (custom - steel)	1		\$500.00	\$500.00
<b>Interior elements</b>					
	Angled partition wall (between bathroom and store space)	1		\$100.00	\$100.00
	Partition wall and doors combo	1		\$300.00	\$300.00
	Ladder	2		\$50.00	\$100.00
	Toilet	1		\$500.00	\$500.00
	Sink (Custom)	1		\$150.00	\$150.00
	Shower/tap system (Custom)	1		\$350.00	\$350.00
	Kitchen cube	1		\$1,500.00	\$1,500.00
	Folding bench (Bed/bench/seat)	1		\$200.00	\$200.00
	Folding bunk	1		\$150.00	\$150.00
	Store room clothes rail	1		\$30.00	\$30.00
	Store room shelf	1		\$20.00	\$20.00
<i>Excludes site work.</i>				<b>Total cost (Excluding labour):</b>	<b>\$16,637.50</b>

The above figures are rough cost estimates taken from Rawlinson's Quantity Surveyors cost specification document. Prices used are of the highest rate specified and are rounded to the nearest whole. This is to cover inflation and contingency. The final rough estimate excludes site work and labour due to the fact that the user should be able to assemble the dwelling and prepare the site themselves. Costs associated with permits, consents and the connection to services are excluded. Prices will vary depending on location and the design/build preferences of the user.





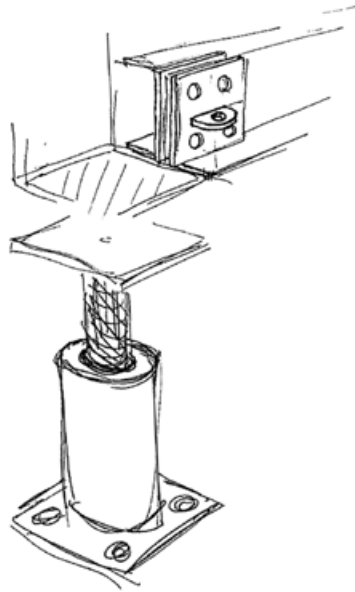
*Figure. 5. 27. Final physical model showing structure.*





Figure. 5. 28. Final physical model with cladding & foundations.

## Construction



*Figure. 5. 29. Sketch showing exploded screw-jack foundation function and components.*

A screw-jack foundation system allows the adjustable foundation design to be possible. To prevent torsion and collapse of the dwelling during an earthquake or extreme weather conditions, adjustable bracing is incorporated along three sides of the foundations. The fourth side remains open for ease of access to the area below the dwelling, convenient for maintaining services and providing extra space for storage or shelter. Adjustability of bracing is achieved through the use of a coupling, which houses the steel bracing rods, allowing them to move in and out when the foundations are raised or lowered.

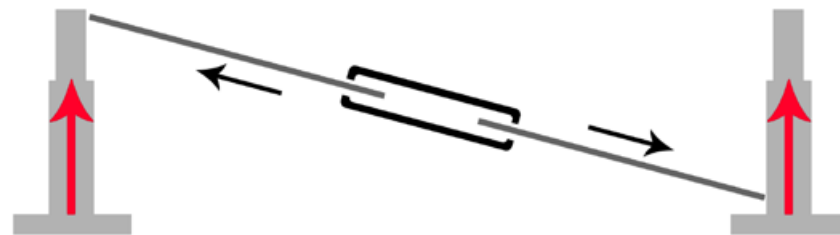
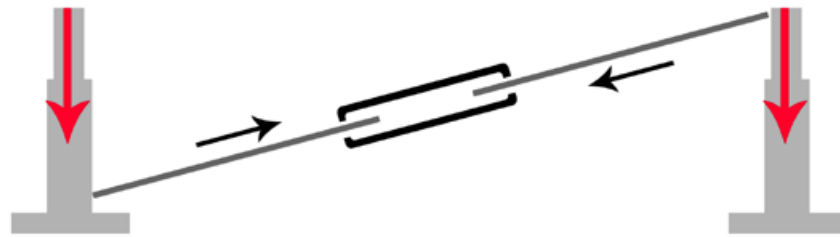
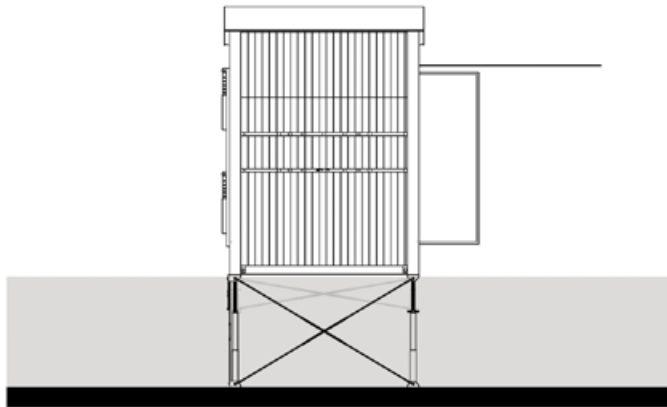


Figure. 5. 30. Top image showing bracing rods with coupling of foundation system. Black arrows show the direction the rods move when the foundations are lowered.

Figure. 5. 31. Middle image showing bracing rods with coupling of foundation system. Black arrows show the direction the rods move when the foundations are raised.

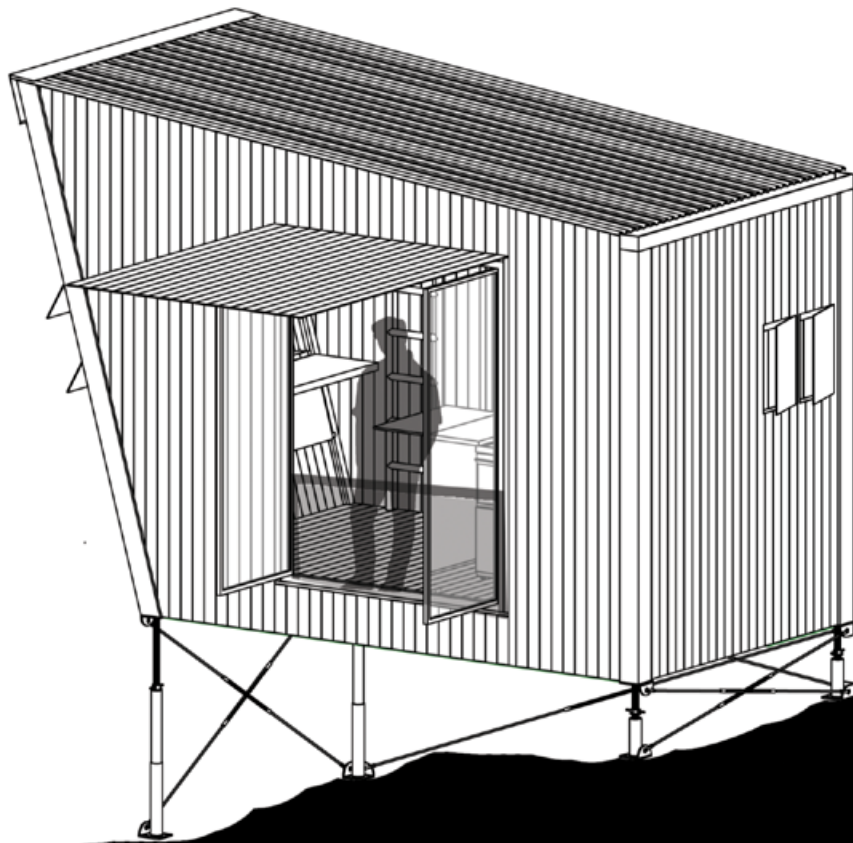
Figure. 5. 32. Bottom image shows plan view of dwelling, with structural bracing on three sides. The displacement between the COM & COR is relatively small therefore a lower amount of torsion would occur under lateral stresses.



*Figure. 5. 33. South elevation with 1500mm high foundations at 1:100*



*Figure. 5. 34. East elevation with 1500mm & 500mm high foundations adapting to an uneven ground surface. Scale 1:100*



*Figure. 5. 35. Perspective view at 1:50.*

The adjustable foundation system allows the AdAPTA-Home to sit on any site, such as a steep slope or uneven ground surface. Extra structure would need to be incorporated into the design for access to the interior.

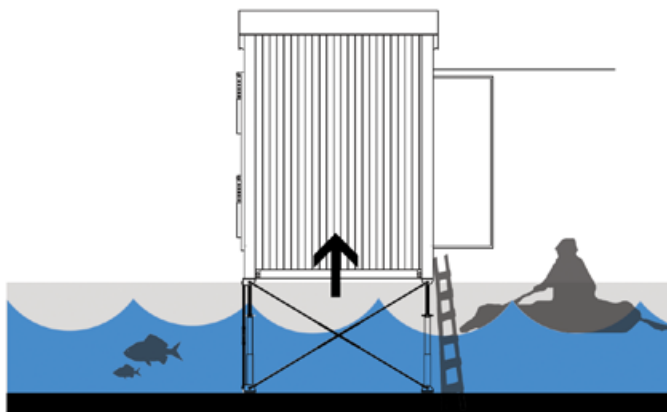


Figure. 5. 36. South elevation with 1500mm high foundations at 1:100

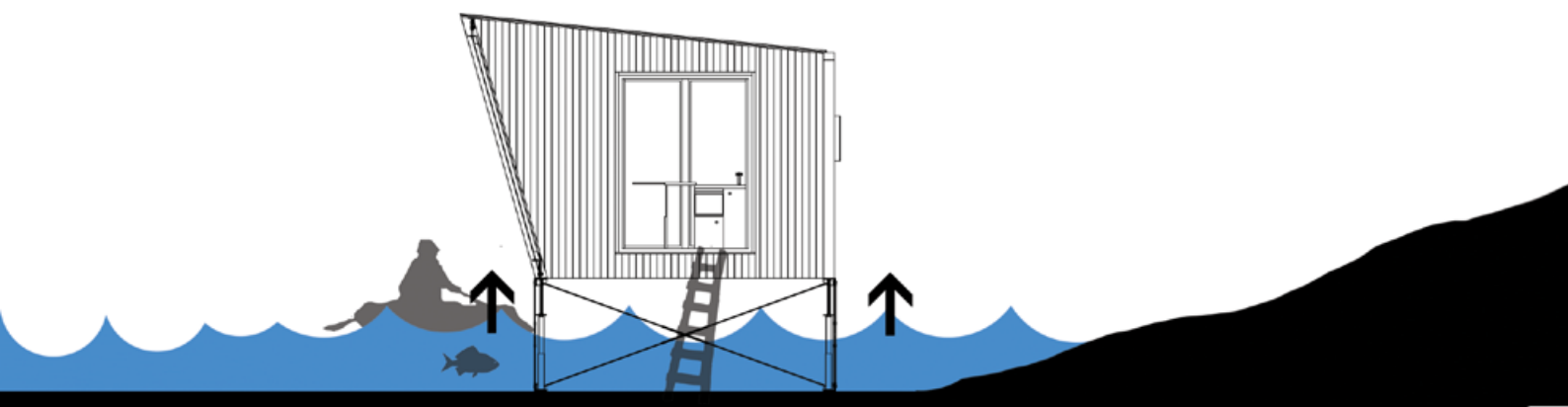


Figure. 5. 37. East elevation with 1500mm high foundations at 1:100



*Figure. 5. 38. Perspective with 1500mm high foundations at 1:50*

Raising the foundations to their highest limit allows for extra space below for storage or entertaining, however more importantly responds to an extreme situation such as a flood, where the dwelling can be raised to prevent flooding inside the dwelling.

## Services

### 1. POWER

Solar panels on the roof create enough energy to power a light, power point and small fridge. A gas callifont located beneath the AdAPTA-Home not only heats the water, but also supplies back up energy to power a gas fridge and gas oven/stove.

### 2. WATER

Water is collected on the roof and gutter at the rear of the dwelling. Hollow columns allow for drainpipes to run inside them, concealing them from view and keeping all services contained within the 10m<sup>2</sup> area. Flexible hoses carry the water from the base of these pipes to an underground holding tank where a pump would be used to pump water up to the dwelling through connections in the floor. The flexibility of the hoses allows for movement when the dwelling is raised or lowered.

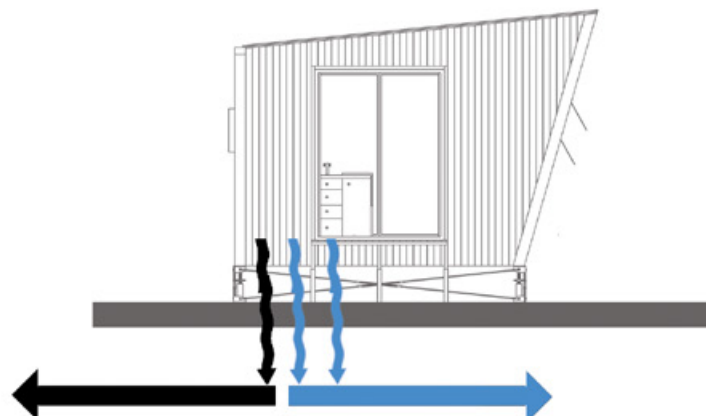
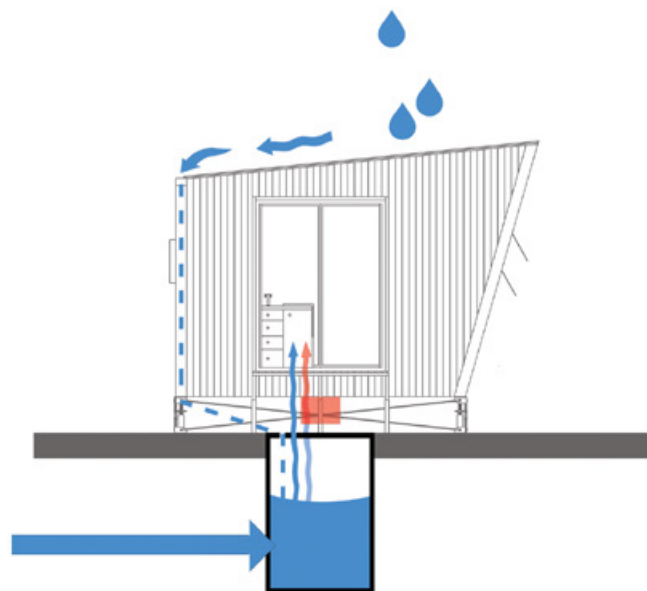
The water tank is located beneath the dwelling, far enough away from the concrete foundation footings to eliminate pounding in the occurrence of earthquakes. Where rain water collection is not enough to sustain the needs of the occupant, the water tank could also be connected to mains water supply. Water is heated via gas callifont beneath the floor as water is pumped up from the tank to multiple connections in the floor panels. These service connections in the floor allow for more flexibility, where the kitchen cube could be disconnected and wheeled outside for outdoor entertaining. This not only responds to the indoor/outdoor living style of New Zealander's, but can be adapted to other cultures, where a kitchen or fixed services are not a priority and therefore not required.

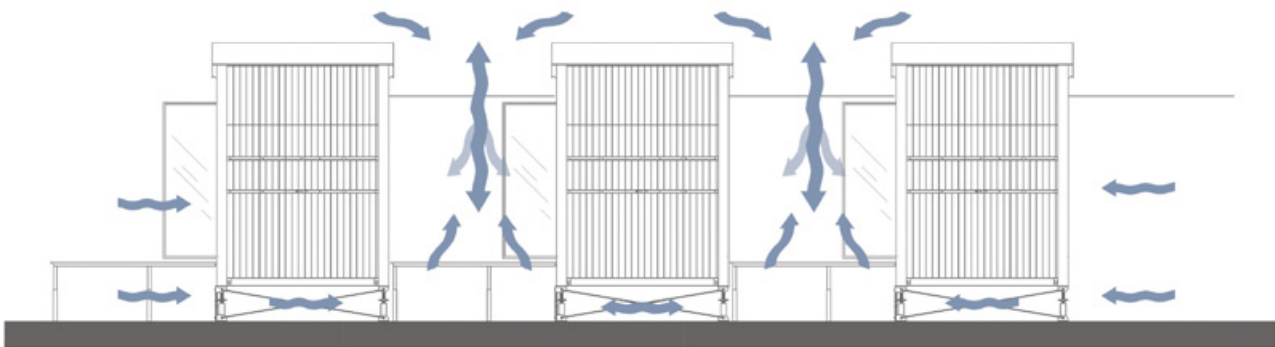
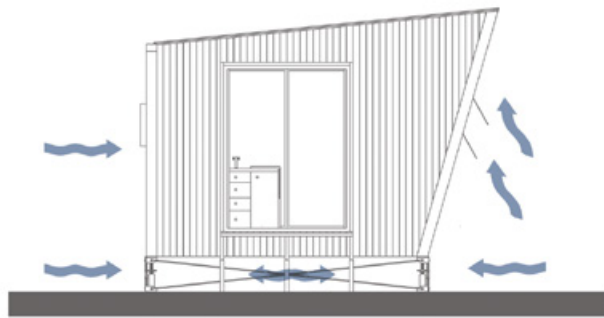
### 3. WASTE

Grey water can either be connected to sewage systems or utilised for other purposes such as watering a garden, but would require an extra holding tank beneath the dwelling. Black water is transported away from site via a sewage system, or an in-ground septic tank.

The above services give the user the option for a home that could be off-grid or fully connected to mains services.





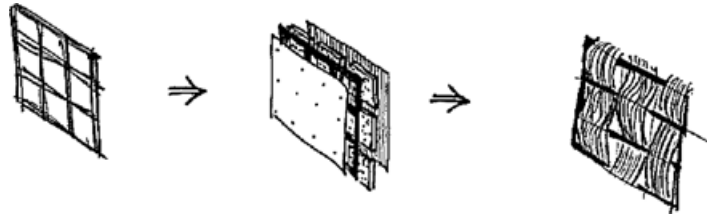


#### 4. VENTILATION

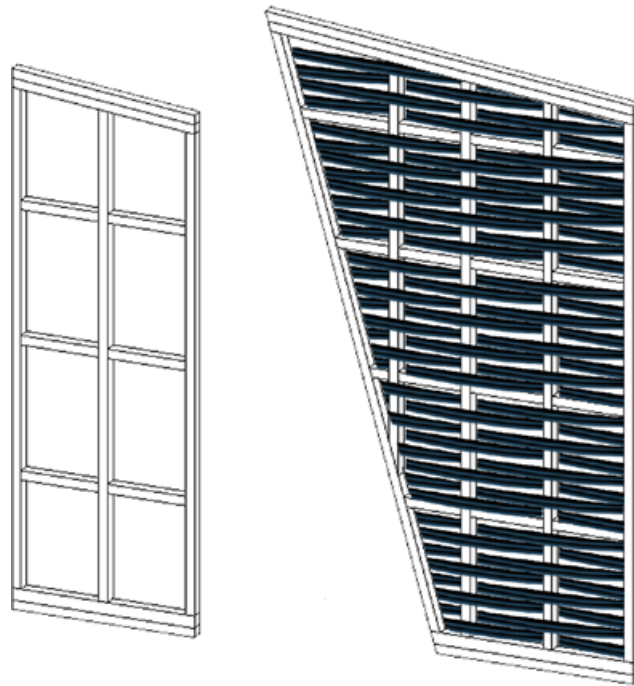
Ventilation is easily achieved due to the opening windows and doors. Furthermore, the raised design allows air to flow continuously under the dwelling, keeping it cool and eliminating the build-up of moisture. This is particularly important when the dwellings are grouped together, the open space beneath allows air to flow between each dwelling, keeping each one well ventilated and therefore a healthy space to live in.

The AdAPTA-Home can also be altered to suit other environments where extra ventilation is needed, such as humid tropical environments. The option for the wall panels to come without cladding, having framing only, allows users in different environments to adapt the panels to their needs; i.e. creating screens from local materials that allow privacy but allow for more airflow through the dwelling. This can also occur in the floor panels, where insulation beneath the floor would not be as necessary as it would be in a New Zealand context.

*Figure. 5. 40. Diagrams showing ventilation.*



*Figure. 5. 41. Sketches of framed option, fully clad and insulated option, and a screen panel option.*



*Figure. 5. 42. Framed panel and panel with weaved screening for privacy and ventilation.*

## Multiplication

Beginning as a small 10m<sup>2</sup> dwelling on borrowed land, the user has a better chance at saving money for their own section and to cover building consent costs at the next stage. The ability for the dwelling to be repeated responds to the likely desire and need for expansion when the user is in a better financial situation. The dwelling can become anything that the user may need or desire, such as a starter home that they can

own in a short period of time, before being able to be expanded for a growing family. Due to the dwellings small footprint and modular construction nature, the home could also be dismantled and moved between sites at a lower cost than traditional house moving. This opens up an option for the dwelling to become a bach or retreat space if the user no longer needed the dwelling for their main residence.



Figure. 5. 43. Render of combined option.

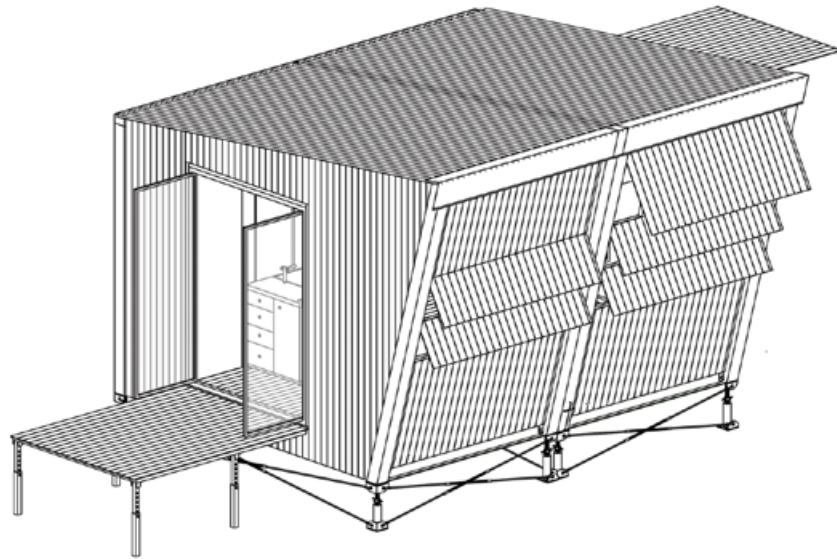


Figure. 5. 44. Perspective of combined option.

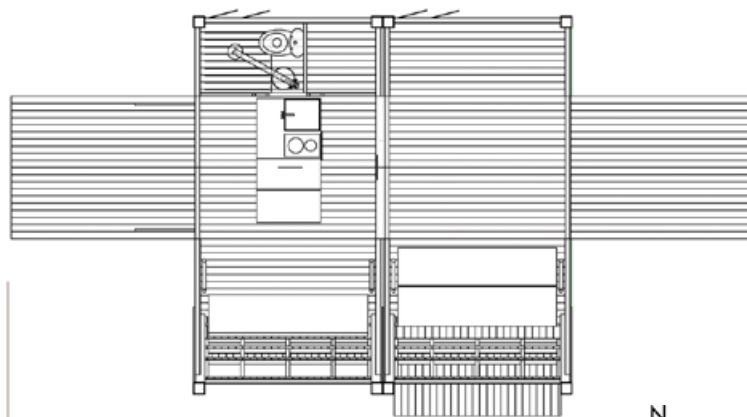


Figure. 5. 45. Ground floor at 1:100

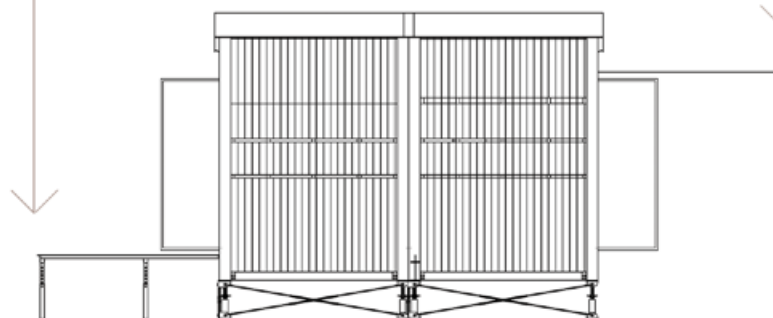
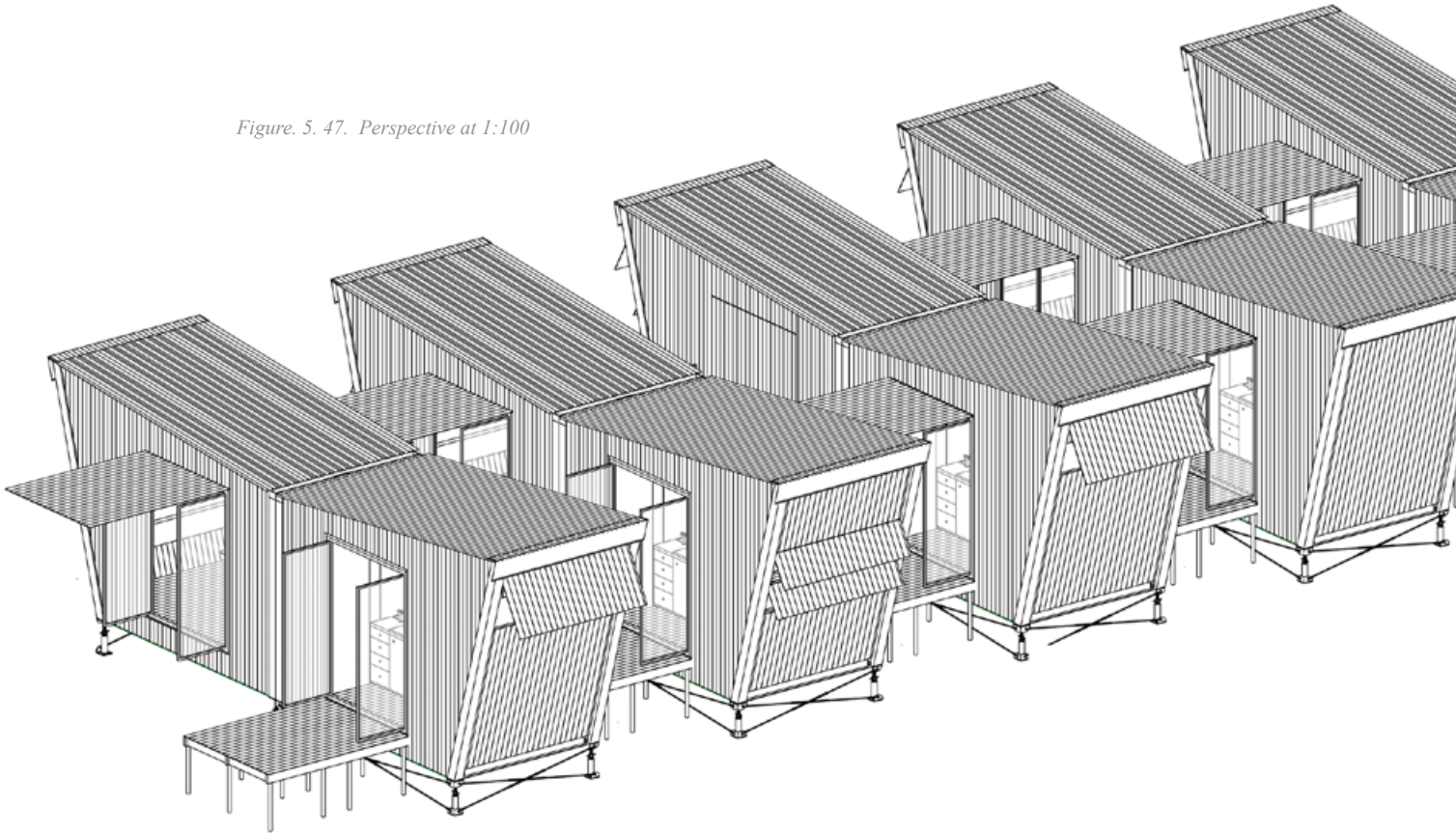


Figure. 5. 46. South elevation at 1:100

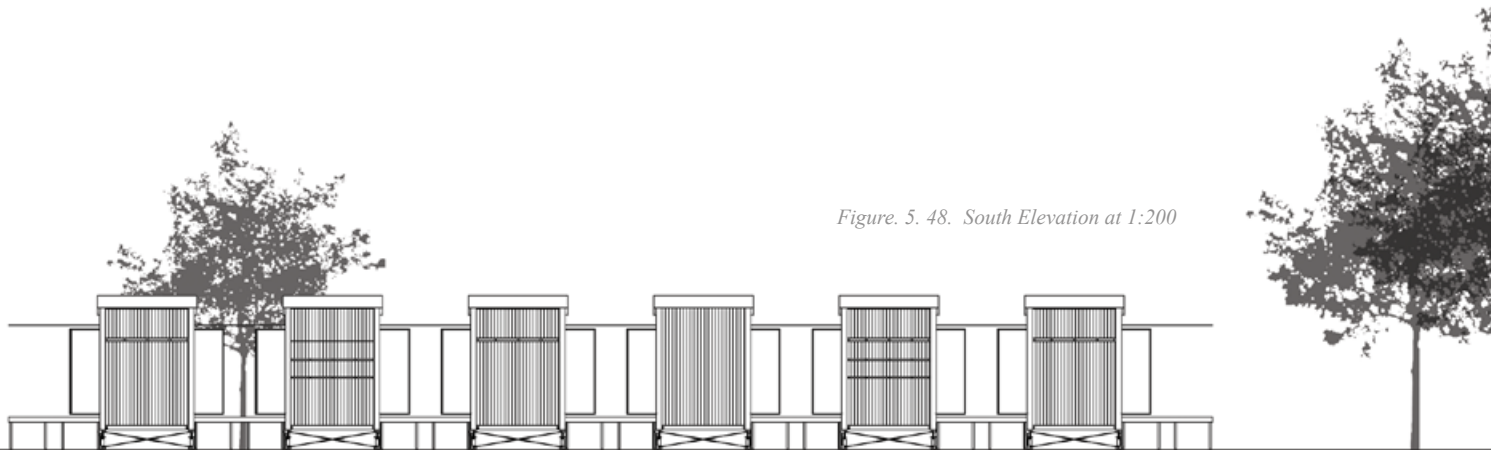


Figure. 5. 47. Perspective at 1:100



Another option for multiplication is to use the folding deck and shelter spaces at each side of the dwelling as an extension of the interior spaces. This is useful in a community environment. The configuration and proximity of each connected dwelling can be altered according to preference, i.e. for a more open environment they can be connected parallel and back to back, or for a more private configuration, can sit off-centre, as shown in figure 5.30.

Figure. 5. 48. South Elevation at 1:200



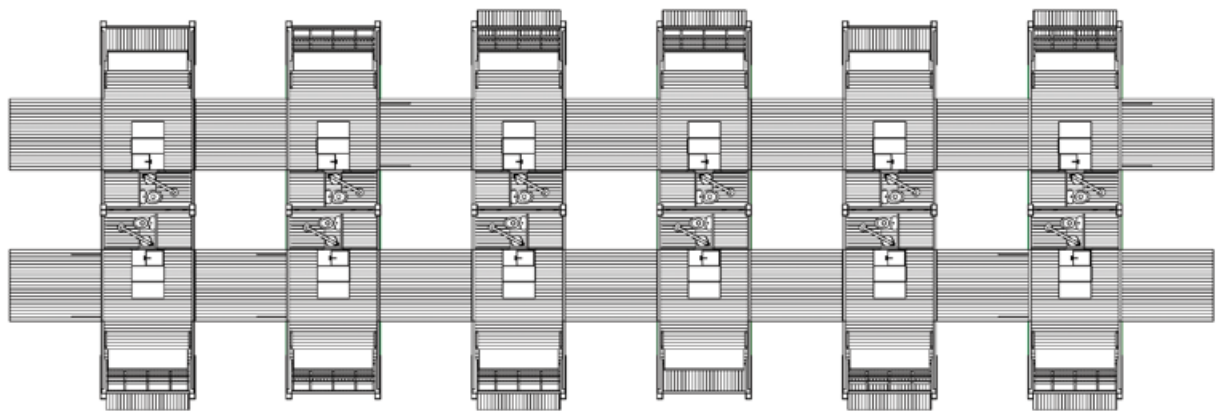
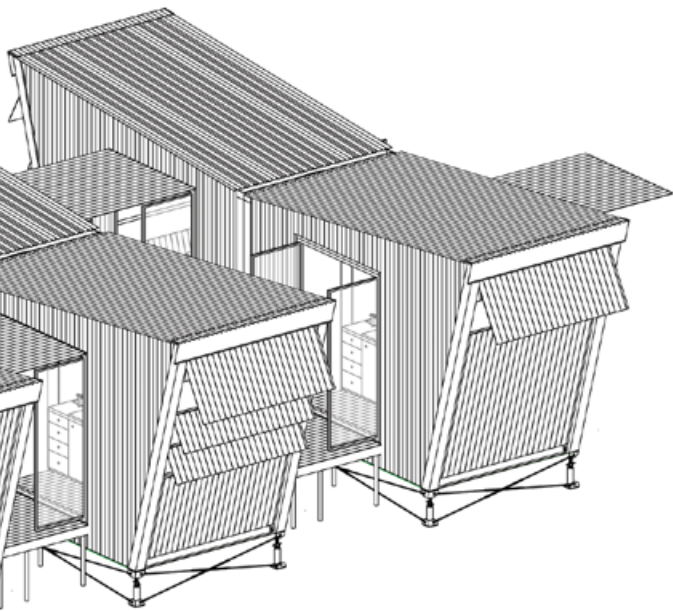


Figure 5. 49. Floor Plans - Grouped Options at 1:200

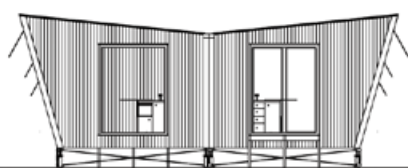
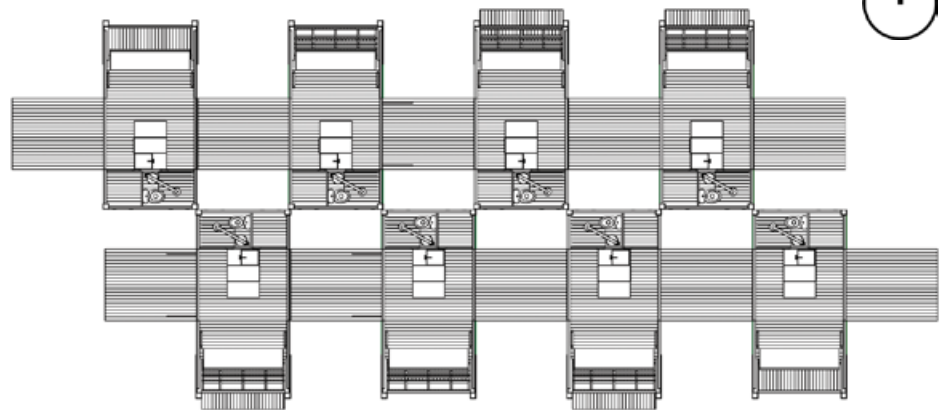


Figure 5. 50. East Elevation at 1:200



*Figure. 5. 51. Community elevation.*







*Figure. 5. 52. Rural accommodation render*







# CHAPTER SIX

## APPLICATION & LOGISTICS

## Site Application:

The AdAPTA-Home is adaptable to any site, situation or environment. For extreme sites or hard-to-access locations, each individual building element can be helicoptered to site for the user to assemble. Each element can also be transported via truck to more easily accessible sites and in situations where multiple dwellings are needed.

Other applications:

- A bach
- Extra accommodation
- A student housing village
- A resort/hotel accommodation
- A retreat/studio space
- Post-disaster/emergency accommodation
- Off-shore housing adaptable to various environments amongst a range of cultures.

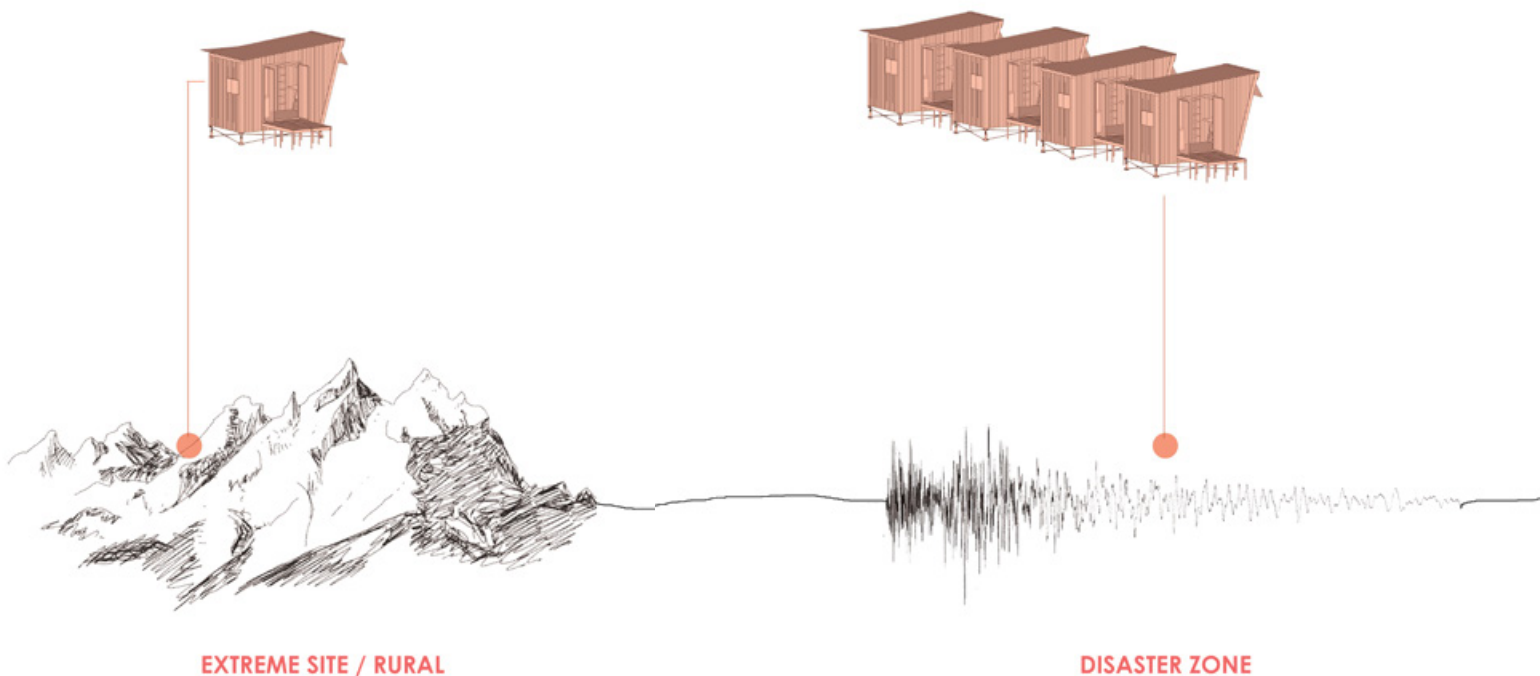


Figure. 6. 01. Extreme site.

Figure. 6. 02. Disaster zone site.

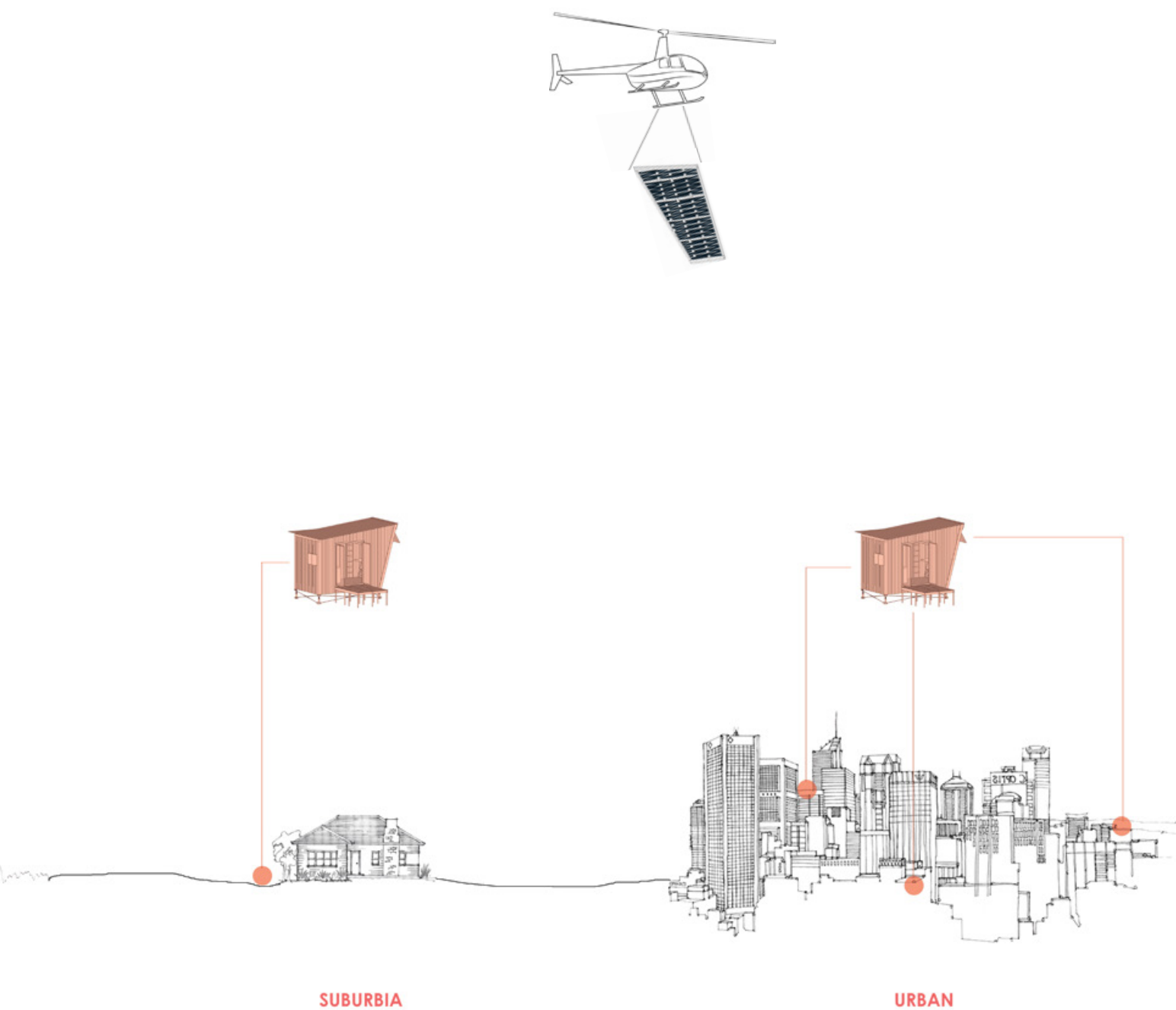


Figure. 6. 03. Helicopter transportation of each building element.

Figure. 6. 04. Suburban site.

Figure. 6. 05. Urban site.

# The AdAPTA Home

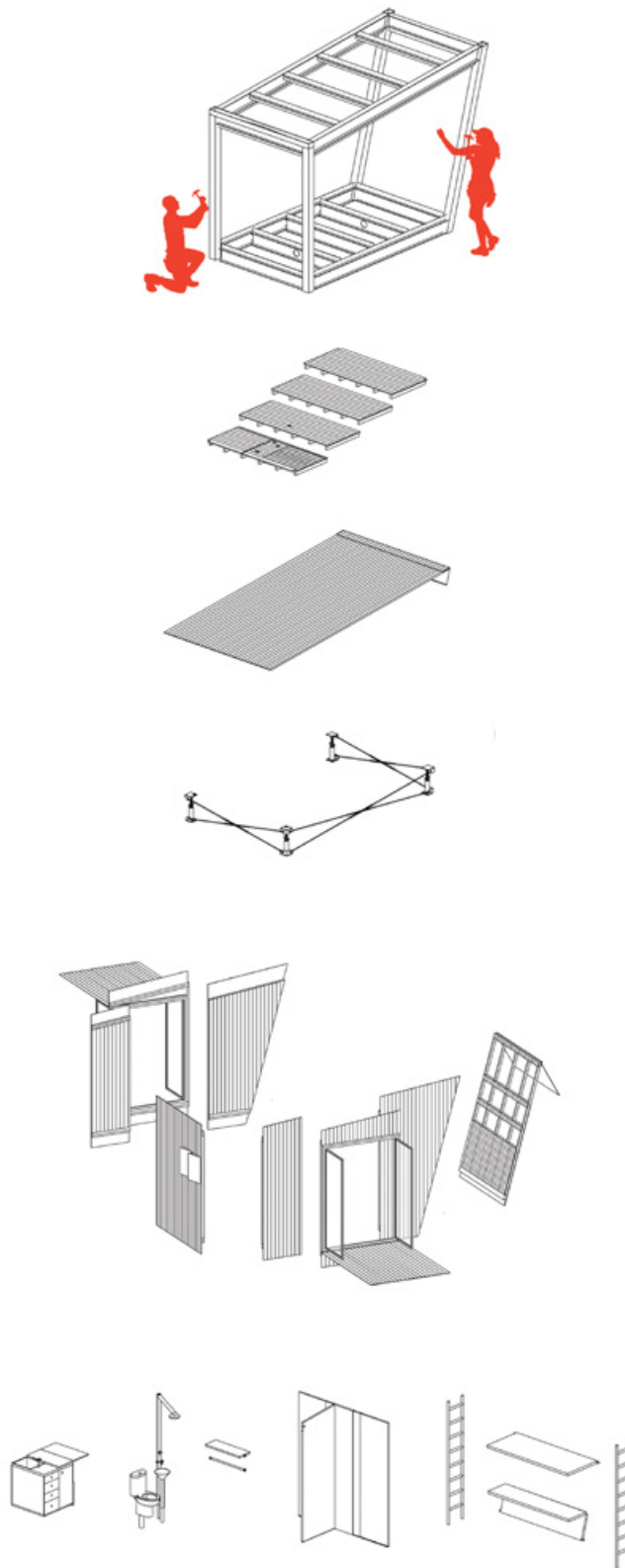
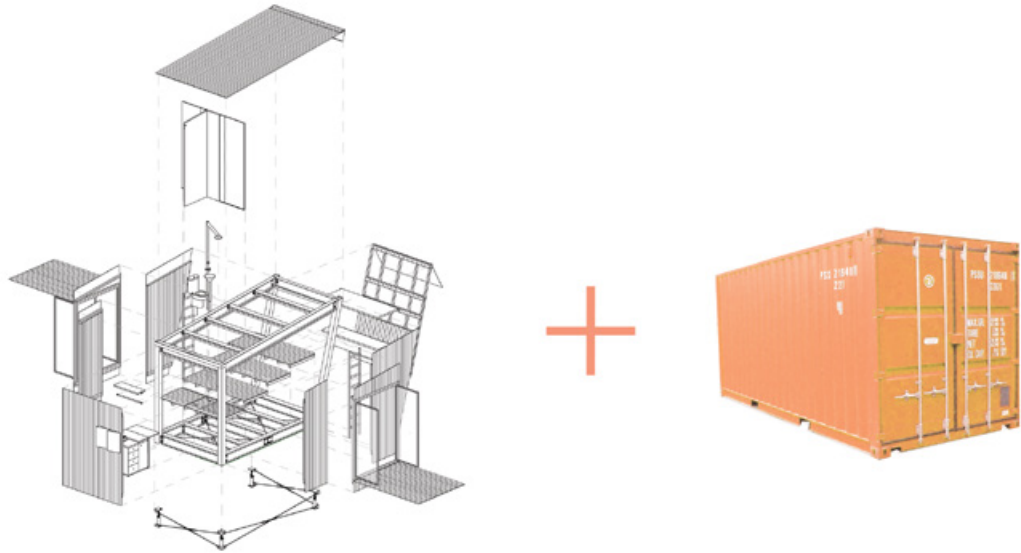


Figure. 6. 06. AdAPTA-Home components.

Figure. 6. 07. (Opposite) All components fit into a container.

Figure. 6. 08. Shipping worldwide.





- Total volume of all combined building members and objects when dismantled:

**9m<sup>3</sup>**

- 40ft container: 67.6m<sup>3</sup> volume therefore can fit 7 dismantled ADAPTA-Homes within.

It is most economical when shipped in a 40ft container, therefore a 20ft container is unnecessary. In a situation requiring shipping it is assumed there would be larger orders

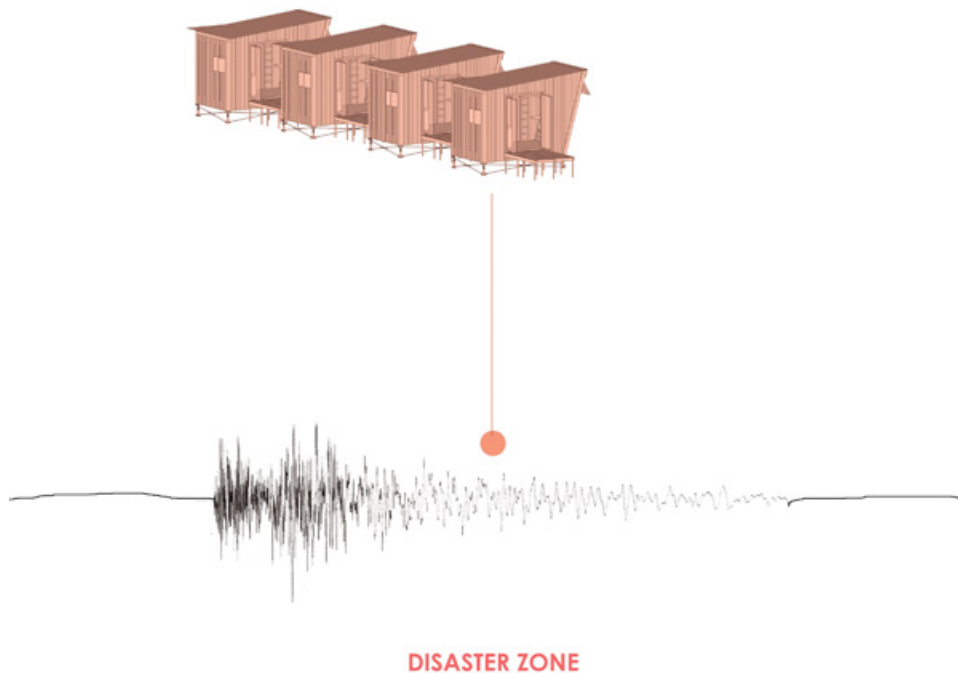


### ***Post Disaster Application:***

The flexibility in the design allows for many different configurations and aesthetics for the AdAPTA-Home. This is particularly useful in emergency situations where speed, cost and flexibility are key. Post-disaster and emergency housing examples usually respond to these factors, however they generally lack permanence, individuality and homeliness.

In many post-disaster situations, housing is usually provided on a temporary basis, however, with delays in government responses and solutions,

the temporary housing phase often lasts longer than intended. For those who are displaced after a disaster and have experienced some form of loss, the absence of a place to call home can be distressing. The AdAPTA-Home aims to provide an inspiring space that is attainable, affordable and able to be built fast in response to a disaster; however more importantly it is a safe and inspiring place to call home, that can be transformed into a permanent home as the disaster situation resides, making the AdAPTA-Home economical in every sense.






*Figure. 6. 09. (Opposite) Disaster zone application.*

*Figure. 6. 10. Render of established AdAPTA-Homes after a disaster and the ability for it to become permanent housing.*





# CHAPTER SEVEN

## CONCLUSION

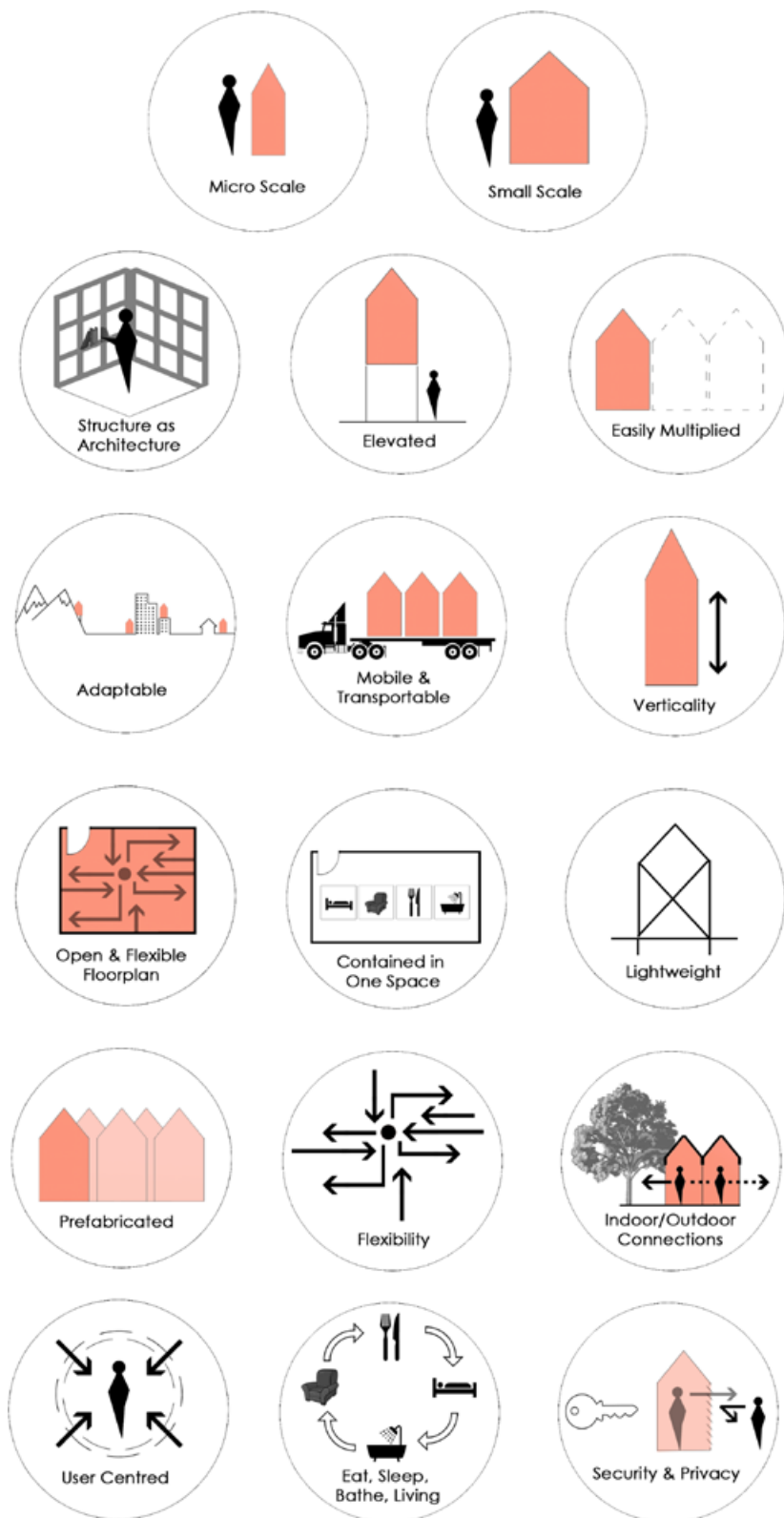


Figure. 7. 01. Diagrams of key characteristics brought through the final design, informed by precedent research.



### Summary

Housing in New Zealand is currently seen as unaffordable and unattainable for young New Zealander's who seek home ownership.

This thesis has explored an alternative housing option to traditional house examples that are no longer viable for first home buyers. In response to the current housing crisis in New Zealand, the final design proposes an affordable and adaptable option that can be obtained in a shorter timeframe than with traditional housing typologies and methods of ownership. The proposed design can also be built by the user, responding to the "do it yourself" character of New Zealander's, and can adapt to the changing needs of the user throughout their lifetime.

Research into precedents and literature informed the design testing of spatial requirements and possibilities, specifically relating to the human form and its variability. This resulted in a refined final design that is free from unnecessary objects and excessive space, providing only the fundamental and necessary elements of a home, allowing the user to tailor it to their specific and individual desires. The reduction in scale and superfluous objects not only provides a base for the user to adapt, but reduces costs and makes the design more widely available to those seeking an affordable home to own, without the burden of a large mortgage.

This gives the user greater freedom for other experiences such as higher study, travel, financially supporting family, or to save to travel, or to grow and adapt their home.

### Conclusions from research

The adaptability of the AdAPTA-Home not only provides a more flexible housing option for young New Zealand first home buyers, but provides the opportunity for expansion in response to other current issues in New Zealand such as multi-generational environments and co-living amongst families. Through initial research into how New Zealander's live, particularly amongst Maori and Pacific cultures where there is seen to be great value in co-living, costs are saved and people are more connected to one another. This is particularly important amongst elderly users who require connection and community to avoid feeling isolated or lonely.

The desire to own a home in a short period of time is achievable with the AdAPTA-Home, however it requires the sacrifice of excess space and material objects. The refined way of living with the AdAPTA-Home requires a particular attitude and the user's willingness to alter their living style. Despite this, the design gives young people who are open to an alternative way of living, a more affordable and attainable option for home ownership in the hope that they reach a sense of fulfilment through living in a considered and creatively designed

space, in reference to the research of Maslow's Hierarchy of Needs. For those not open to a refined living style, it is hoped that the refined nature and flexibility of the AdAPTA-Home, can begin a discussion or encourage other users to think about the amount of space they use and how much they truly need.

#### Importance

This research and design proposal is important for housing in New Zealand, not only as a tool to help young people obtain a home of their own, but to provide an option for those who wish to live in larger groups or multi-generational environments, for which no current New Zealand housing model exists or addresses. Despite the main intention being an affordable first home for young people, the adaptability of the design makes it relevant for a diverse range of needs. Other uses for the AdAPTA-Home could include but are not limited to:

- A bach
- Extra accommodation
- A student housing village
- A resort/hotel accommodation
- A retreat/studio space
- Post disaster/emergency accommodation
- Off-shore housing adaptable to various environments amongst a range of cultures.

The prefabrication methods and modularity in the design improves overall efficiency in production, transportation, construction and housing shortages in various environments and situations? Not only has this proven to reduce associated costs and time, but allows the AdAPTA-Home to be more readily available and attainable for a wider range of uses and situations, aside from the main purpose of an affordable first home. The diversity makes the design a desirable and relevant housing option not only for a New Zealand context, but further afield.

#### Future opportunities

There are several opportunities which could further enhance this research, including: a more thorough cost breakdown including permit and consent costs, how alternative methods such as sourcing recycled materials could reduce construction costs, how the AdAPTA-Home could be applied in a third world country or post-disaster situation, and how liveable a 10m<sup>2</sup> space would be over a long period of time.



In all, the research and resultant design of this thesis seeks to provoke thought, promote change and provide an affordable home option, attainable for young New Zealand first home buyers. The proposed design not only satisfies the fundamental need for shelter and warmth, but responds to user variation in a creative way. In addition to providing a mobile, affordable and flexible design option, it's aim is to enhance the quality of life of the user, through well considered design with a sense of uniqueness and creativity; a space where despite a refined scale and reduced amount of superfluous objects, the user can control their living environment, tailoring it to their needs and ultimately feel a sense of completeness and satisfaction. It is paramount that through living in the AdAPTA-Home, the user may live with pride and dignity through owning their own home.



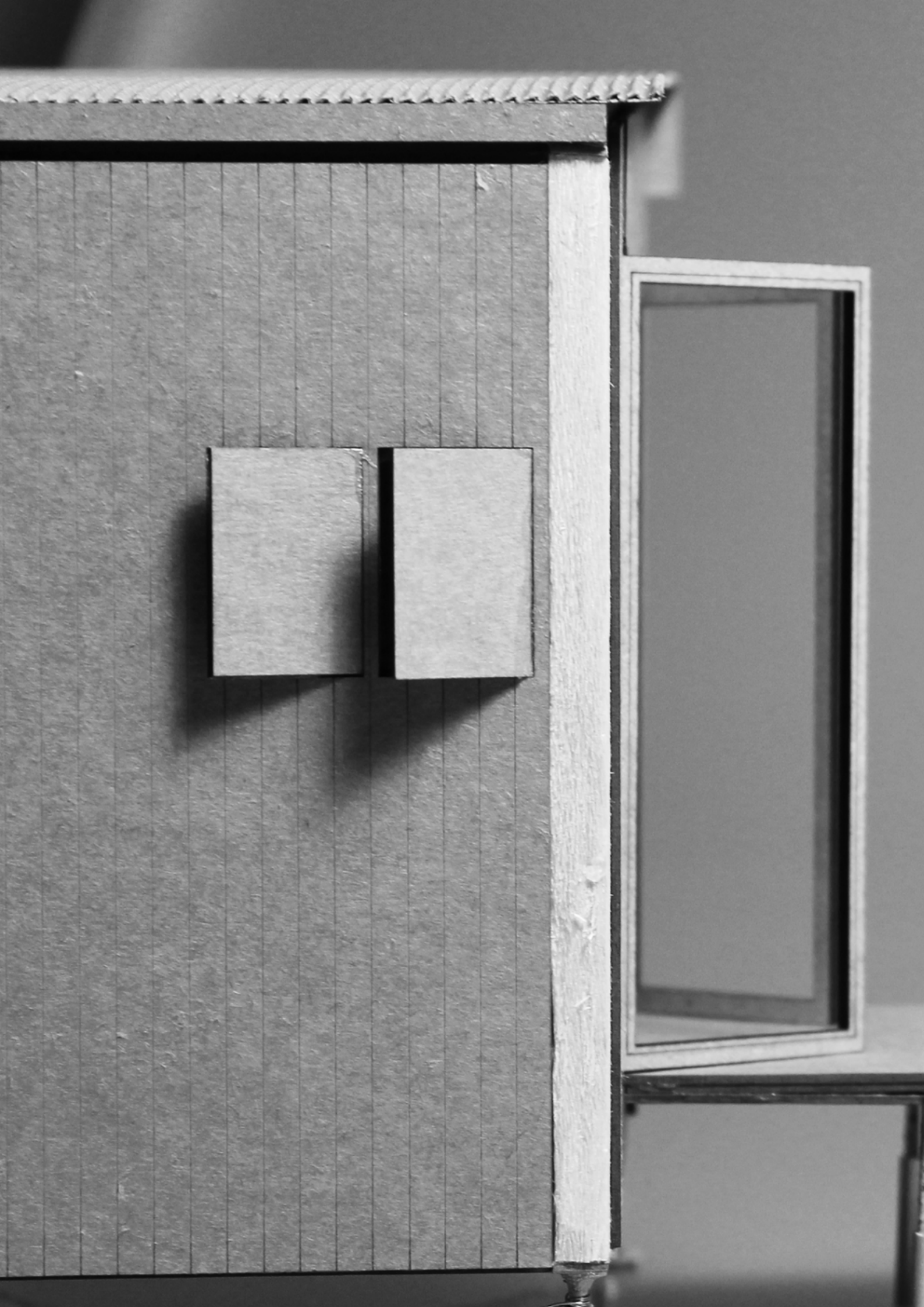


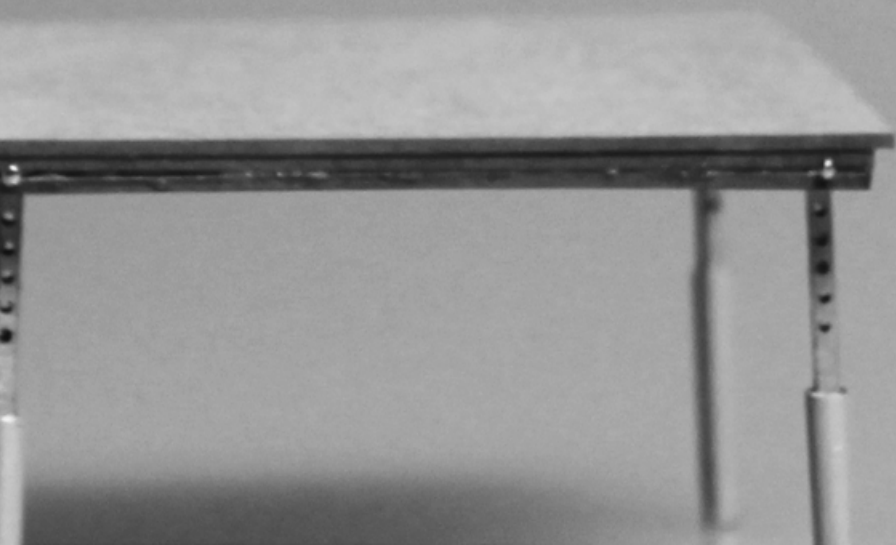




Figure. 7. 02. Render of final AdAPTA-Home design in a grouped layout.







*Figure. 7. 03. Photograph of final physical model.*



## **BIBLIOGRAPHY & LIST OF FIGURES**

## WORKS CITED

Branz. "Housing Multi-generational Families." Housing Multi-generational Families | Scoop News. Scoop Media, 2 Feb. 2016. Web. 12 Dec. 2016.

"Building Amendment Act 2013." New Zealand Legislation. New Zealand Government, n.d. Web. 18 Dec. 2016.

Cheshire, Pip, and Patrick Reynolds. *Architecture Uncooked: The New Zealand Holiday House through an Architects Eye*. Auckland, N.Z.: Godwit, 2008. Print.

"Children and Young People Charged in Court - Most Serious Offence Calendar Year." Children and Young People Charged in Court - Most Serious Offence Calendar Year. NZ.Stat, n.d. Web. 12 Dec. 2016.

Cohen, Jean-Louis. "Le Corbusier's Modulor and the Debate on Proportion in France." *European Architectural History Network*. Ubiquity Press, 2014. Web. 09 Jan. 2017.

Enoka, Mava. "What It's like to Be Young and Unemployed in New Zealand." *The Wireless*. N.p., 26 May 2015. Web. 12 Dec. 2016.

McLeod, Saul. "Maslow's Hierarchy of Needs." *Simply Psychology*. N.p., 16 Sept. 2013. Web. 14 Dec. 2016.

National Library of Scotland. "Albrecht Dürer: 'Vier Bücher Von Menschlicher Proportion'." National Library of Scotland. National Library of Scotland, n.d. Web. 09 Jan. 2017.

Pheasant, Stephen, and Christine M. Haslegrave. *Bodyspace: Anthropometry, Ergonomics and the Design of Work*. Boca Raton, FL.: Taylor & Francis, 2006. Print.

Pollio, Vitruvius. *Vitruvius: The Ten Books on Architecture*. Trans. Morris Hicky Morgan. Miami, FL: Hardpress, 2012. 27 Mar. 2008. Web. 10 May 2016.

Renzi, Jen. "Le Corbusier's One-Room Wonder." *The Wall Street Journal*. N.p., 14 June 2013. Web. 18 Apr. 2016. <<http://www.wsj.com/articles/SB10001424127887323495604578539330498779980>>.

Richards, Simon, and Le Corbusier. *Le Corbusier and the Concept of Self*. New Haven: Yale UP, 2003. Print.

Satherley, Dan. "Split between Property Haves and Have-nots." *Split between Property Haves and Have Nots | Business | Newshub*. Newshub, 7 Apr. 2016. Web. 12 Dec. 2016.

Schrader, Ben. "Maori Housing – Te Noho Whare." *Te Ara. Te Ara - the Encyclopedia of New Zealand*, 5 Sept. 2013. Web. 12 Dec. 2016.

Sloterdijk, Peter. *The Communist 'Egosphere'* N.p.: n.p., n.d. PDF.



Speedy, Erin. "Calls for More Support to Help University Students." Stuff. N.p., 30 Mar. 2016. Web. 12 Dec. 2016.

StatisticsNZ. "Loneliness in New Zealand." Statistics New Zealand. NZ Govt, 2010. Web. 17 Jan. 2017.

StatisticsNZ. "We're Building Bigger 40 Years on." Statistics New Zealand. N.p., 5 Oct. 2016. Web. 14 Dec. 2016.

Thompson, Paul. The Bach. Wellington, N.Z.: Government Printer, 1985. Print.

Twyford, Phil. "Homeownership Rates Fall under National." New Zealand Labour Party. N.p., 8 Apr. 2016. Web. 12 Dec. 2016.

Watkins, Tracy, and Andy Fyers. "House Price Rises Creating a Generation of Renters." Stuff. N.p., 20 May 2015. Web. 13 Dec. 2016.

## REFERENCES

Giddens, Cathy, ed. Rawlinsons New Zealand Construction Handbook 2011 26 (2011): n. pag. Te Waharoa - Victoria University Library. Rawlinsons Media Limited, 2011. Web. 17 Jan. 2017.

"Shipping Container Dimensions." ADDIS Containers. N.p., n.d. Web. 17 Jan. 2017.

Wright, Frank Lloyd. "Quote - F.L.Wright." Goodreads. Goodreads Inc, n.d. Web. 17 Jan. 2017.

## LIST OF FIGURES

- Figure 0.1 – Cover image, photograph of final physical model in photography room.  
*Image by Author.*
  - Figure 0.2 – Photograph of author presenting final model at 2016 review.  
*Image by Author.*
  - Figure 0.3 – Photograph of final model set up for photography.  
*Image by Author*
  - Figure 0.4 – Digital artwork representing an escape from the formalities of everyday living.  
*Image by Author.*
  - Figure 0.5 – photograph of final physical model.  
*Image by Author.*
1. CHAPTER ONE
- Figure 1.06 – Graph showing NEET results for NZ youth.  
*Statistics NZ, and Mava Moayyed. NEET Graph - Youth NZ. Digital image. The Wireless. NZ on Air, 26 May 2015. Web. 25 Jan. 2017.*
  - Figure 1.07 – Concept sketch.  
*Image by Author.*
  - Figure 1.08 – Diagram showing thesis structure and process.  
*Image by Author.*
  - Figure 1.09 – Photograph of final physical model.  
*Image by Author.*
2. CHAPTER TWO
- Figure 2.01 – NZ Railway poster promoting suburban living.  
*Thorns, David, and Ben Schrader. Railway Poster. Digital image. Te Ara - The Encyclopedia of New Zealand. Newzealand.govt.nz, 11 Mar. 2010. Web. 19 Dec. 2016.*
  - Figure 2.02 – Sketch of hut.  
*Image by Author.*
  - Figure 2.03 – Maslow's hierarchy of needs triangle.  
*McLeod, Saul. Maslow's Hierarchy of Needs. Digital image. Simple Pyscology. N.p., 2007. Web. 15 Dec. 2016.*
  - Figure 2.04 – Image of traditional NZ bach.  
*Schrader, Ben. Hātepe Bach. Digital image. Te Ara - The Encyclopedia of New Zealand. N.p., 5 Sept. 2013. Web. 10 Jan. 2017.*
  - Figure 2.05 – Image of large NZ holiday home.  
*View of Property from the Road - Rotorua Holiday Home. Digital image. Bookabach. Bookabach Ltd., n.d. Web. 10 Jan. 2017. <<https://images.bookabach.co.nz/property-images/30969/listing/353173XL.jpg>>.*
  - Figure 2.06 - Nikolaj Miljutin's Living Cell in Russia 1930.  
*Nikolaj Miljutin, Living Cell. Digital image. Academia. N.p., 2015. Web. 21 Dec. 2016. <[http://www.academia.edu/4758776/The\\_Communist\\_Egosphere\\_The\\_One-Room\\_Abode\\_in\\_the\\_Russian\\_1920s\\_in\\_Dom\\_Narkomfin](http://www.academia.edu/4758776/The_Communist_Egosphere_The_One-Room_Abode_in_the_Russian_1920s_in_Dom_Narkomfin)>.*
  - Figure 2.07 – Hand study sketch.  
*Image by Author.*
  - Figure 2.08 – User centered design sketch.  
*Image by Author.*
  - Figure 2.09 – Vitruvian man.  
*Vitruvian Man. Digital image. Leonardo Da Vinci. Stanford University, 2002. Web.*

21 Dec. 2016. <<http://leonardodavinci.stanford.edu/submissions/clabaugh/history/leonardo.html>>.

- Figure 2.10 – Le Corbusier’s Modulor Man drawing.  
*Beilharz, Kirsty. Modulor Man. Digital image. The Journal of Design Research. N.p., 2004. Web. 21 Dec. 2016. <<http://www.inderscience.com/jdr/backfiles/articles/issue2004.02/Art2.html>>.*
- Figure 2.11 – Sketch of human figures representing diversity.  
*Image by Author.*
- Figure 2.12 – Image of Hut on Sleds closed.  
*Hut on Sleds - Closed. Digital image. Crosson Architects. N.p., n.d. Web. 7 Dec. 2016.*
- Figure 2.13 – Image of Hut on Sleds open.  
*Hut on Sleds - Open. Digital image. Crosson Architects. N.p., n.d. Web. 7 Dec. 2016.*
- Figure 2.14 – Image of tractor moving Hut on Sleds.  
*Tractor towing Hut on Sleds. Digital image. Crosson Architects. N.p., n.d. Web. 7 Dec. 2016.*
- Figure 2.15 – Image of Hut on Sleds open at night.  
*Open hut during evening. Digital image. Crosson Architects. N.p., n.d. Web. 7 Dec. 2016.*
- Figure 2.16 – Diagrams of case study characteristics.  
*Image by Author.*
- Figure 2.17 – image of 1m2 house configurations  
*Tiny-house.jpg. Digital image. Geekologie. N.p., n.d. 24 July. 2012. Web. 9 Dec. 2016.*
- Figure 2.18 – Image of 1m2 house mobility  
*World’s smallest house - Mobility. Digital image. Architecture Art Designs. N.p., n.d. Web. 9 Dec. 2016.*
- Figure 2.19 - Diagrams of case study characteristics.  
*Image by Author.*
- Figure 2.20 – Image of Microhotel perspective render.  
*Microhotel Perspective Render. Digital image. Kutarq Studio. N.p., 2012. Web. 9 Dec. 2016.*
- Figure 2.21 – Image of Microhotel end view.  
*Microhotel End view - openings for deck & shelter. Digital image. Kutarq Studio. N.p., 2012. Web. 9 Dec. 2016.*
- Figure 2.22 – Image of Microhotel floorplan.  
*Microhotel Floorplan - fully open. Digital image. Kutarq Studio. N.p., 2012. Web. 9 Dec. 2016.*
- Figure 2.23 – Diagrams of case study characteristics.  
*Image by Author.*
- Figure 2.24 – Image of Keret House perspective section.  
*Keret House - Perspective Revealing Structure. Digital image. Twisted Sifter. N.p., 30 Mar. 2016. Web. 9 Dec. 2016.*
- Figure 2.25 – Photograph of Keret house between two buildings.  
*Keret House – Between two buildings. Digital image. Twisted Sifter. N.p., 30 Mar. 2016. Web. 9 Dec. 2016.*
- Figure 2.26 – Photograph of Keret House interior.  
*Keret House – Interior View. Digital image. Twisted Sifter. N.p., 30 Mar. 2016. Web. 9 Dec. 2016.*
- Figure 2.27 – Diagrams of case study characteristics.  
*Image by Author.*
- Figure 2.28 – Image of mobile kitchen, office and bedroom.  
*Kenchikukagu\_top. Digital image. Atelier OPA. N.p., 2010. Web. 9 Dec. 2016.*

- Figure 2.29 – Image of mobile kitchen, office and bedroom when closed.  
*Kenchikukagu\_top\_2. Digital image. Atelier OPA. N.p., 2010. Web. 9 Dec. 2016.*
- Figure 2.30 – Diagrams of case study characteristics.  
*Image by Author.*
- Figure 2.30 – Image of transportation of Mobile M House via truck.  
*Mobile M-House, Transportation. Digital image. Michael Jantzen. N.p., n.d. Web. 9 Dec. 2016.*
- Figure 2.30 – Image of various configurations of Mobile M House.  
*Mobile M-House, Folding façade panels. Digital image. Michael Jantzen. N.p., n.d. Web. 9 Dec. 2016.*
- Figure 2.30 – Diagrams of case study characteristics.  
*Image by Author.*
- Figure 2.30 – Diagrams of case study characteristics.  
*Image by Author.*

### 3. CHAPTER THREE

- Figure 3.01 – Diagram showing 10m<sup>2</sup> building area with 1m<sup>2</sup> spaces within.  
*Image by Author.*
- Figure 3.02 – Diagram informed by case studies.  
*Image by Author.*
- Figure 3.03 – 1m<sup>2</sup> area of space to test ergonomic designs, diagram.  
*Image by Author.*
- Figure 3.04 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 3.05 – Figure study of human movement.  
*Image by Author.*
- Figure 3.06 – Figure study showing clearance.  
*Image by Author.*
- Figure 3.07 – Figure study showing posture.  
*Image by Author.*
- Figure 3.08 – Figure study showing reach.  
*Image by Author.*
- Figure 3.09 – Figure study showing strength.  
*Image by Author.*
- Figure 3.10 – Silhouette of human user.  
*Image by Author.*
- Figure 3.11 – 1m<sup>2</sup> space diagrams.  
*Image by Author.*
- Figure 3.12 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 3.13 – Diagrams showing configurations of space.  
*Image by Author.*
- Figure 3.14 – Ergonomic design consideration sketches.  
*Image by Author.*
- Figure 3.15 – Architectural component sketch.  
*Image by Author.*
- Figure 3.16 – Diagrams informed by case studies.  
*Image by Author.*

### 4. CHAPTER FOUR

- Figure 4.01 – Design concept sketch.  
*Image by Author.*

- Figure 4.02 – 1m2 kitchen limitations sketch.  
*Image by Author.*
- Figure 4.03 – Design concept sketches.  
*Image by Author.*
- Figure 4.04 – Sketch of kitchen configuration concept.  
*Image by Author.*
- Figure 4.05 – Render of kitchen concept.  
*Image by Author.*
- Figure 4.06 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 4.07 – 1m2 bathroom space sketches.  
*Image by Author.*
- Figure 4.08 – 1m2 bathroom space testing photographs.  
*Image by Author.*
- Figure 4.09 – 1m2 design plan and section.  
*Image by Author.*
- Figure 4.10 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 4.11 – 1.5m2 bathroom space sketches.  
*Image by Author.*
- Figure 4.12 – 2m2 bedroom/living space concept sketch.  
*Image by Author.*
- Figure 4.13 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 4.14 – Concept sketch for bedroom/living configurations.  
*Image by Author.*
- Figure 4.15 – Layout configurations of bathroom and kitchen sketches.  
*Image by Author.*
- Figure 4.16 – Sketch of preferred layout option.  
*Image by Author.*
- Figure 4.17 – Form and location of spaces.  
*Image by Author.*
- Figure 4.18 – Form and adaptability exploration.  
*Image by Author.*
- Figure 4.19 – Image of concept model 1.  
*Image by Author.*
- Figure 4.20 – Image of concept model 2.  
*Image by Author.*
- Figure 4.21 – Image of concept model 3.  
*Image by Author.*
- Figure 4.22 – Image of concept model 4.  
*Image by Author.*
- Figure 4.23 – Image of concept model 5.  
*Image by Author.*
- Figure 4.24 – Image of concept model 6.  
*Image by Author.*
- Figure 4.25 – Image of concept model 7.  
*Image by Author.*
- Figure 4.26 – Image of concept model 8.  
*Image by Author.*
- Figure 4.27 – Diagram showing height and angle adjustments.  
*Image by Author.*

- Figure 4.28 – Sketches showing angled front wall and options for bunk bed adaption.  
*Image by Author.*
- Figure 4.29 – Sketches showing a folding roof concept.  
*Image by Author.*
- Figure 4.30 – Image of timber materials.  
*Fullalove, Simon. Timber, the Oldest Building Materials, Is Making a Comeback in Construction. Digital image. Ice. Thomas Telford, 30 June 2015. Web. 24 Jan. 2017.*
- Figure 4.31 – Image of aluminium materials.  
*Aluminium1. Digital image. GreeNaval Yachts. N.p., 2016. Web. 24 Jan. 2017.*
- Figure 4.32 – Sketches of opening sides.  
*Image by Author.*
- Figure 4.33 – Sketches in plan showing various configurations.  
*Image by Author.*
- Figure 4.34 – Adjustable foundations sketches.  
*Image by Author.*
- Figure 4.35 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 4.36 – Sketch of adjustable foundation scheme.  
*Image by Author.*
- Figure 4.37 – Stepping stone image.  
*Image by Author.*
- Figure 4.38 – Stepping through each stage sketches and diagrams.  
*Image by Author.*
- Figure 4.39 – Diagrams informed by case studies.  
*Image by Author.*
- Figure 4.40 – Exterior render of stage 1.  
*Image by Author.*
- Figure 4.41 – Interior render of stage 1.  
*Image by Author.*
- Figure 4.42 – Exterior render of stage 2.  
*Image by Author.*
- Figure 4.43 – Interior render of stage 2.  
*Image by Author.*
- Figure 4.44 – Exterior render of stage 3.  
*Image by Author.*
- Figure 4.45 – Interior render of stage 3.  
*Image by Author.*
- Figure 4.46 – Exterior render of stage 4.  
*Image by Author.*
- Figure 4.47 – Interior render of stage 4.  
*Image by Author.*

## 5. CHAPTER FIVE

- Figure 5.01 – Design concept sketch.  
*Image by Author.*
- Figure 5.02 – Final design render 1.  
*Image by Author.*
- Figure 5.03 – Final Design render 2.  
*Image by Author.*
- Figure 5.04 – Final design floorplan.  
*Image by Author.*

- Figure 5.05 – Final design showing various floorplan configurations.  
*Image by Author.*
- Figure 5.06 – North elevation.  
*Image by Author.*
- Figure 5.07 – South elevation.  
*Image by Author.*
- Figure 5.08 – East elevation.  
*Image by Author.*
- Figure 5.09 – West elevation.  
*Image by Author.*
- Figure 5.10 – Section A – long section.  
*Image by Author.*
- Figure 5.11 – Section B – short section.  
*Image by Author.*
- Figure 5.12 – 1m<sup>2</sup> area for kitchen space diagram.  
*Image by Author.*
- Figure 5.13 – Perspective, elevation and plans of kitchen cube.  
*Image by Author.*
- Figure 5.14 – 1:25 scaled kitchen cube plans.  
*Image by Author.*
- Figure 5.15 – 1.5m<sup>2</sup> bathroom space.  
*Image by Author.*
- Figure 5.16 – 1:20 scaled plan of bathroom space.  
*Image by Author.*
- Figure 5.17 – 1:20 scaled perspective of bathroom space.  
*Image by Author.*
- Figure 5.18 – Elevations of bathroom space.  
*Image by Author.*
- Figure 5.19 – 2m<sup>2</sup> space for bedroom and living spaces diagram.  
*Image by Author.*
- Figure 5.20 – Long section highlighting bedroom and living space.  
*Image by Author.*
- Figure 5.21 – Configurations of bedroom and living space.  
*Image by Author.*
- Figure 5.22 – Render of bedroom and living space.  
*Image by Author.*
- Figure 5.23 – Render showing the interior of the AdAPTA-Home.  
*Image by Author.*
- Figure 5.24 – Render showing the exterior of the AdAPTA-Home.  
*Image by Author.*
- Figure 5.25 – Exploded perspective view of the AdAPTA-Home.  
*Image by Author.*
- Figure 5.26 – Table showing cost breakdown and rough estimates of prices.  
*Image by Author.*
- Figure 5.27 – Final physical model showing structure.  
*Image by Author.*
- Figure 5.28 – Final physical model with cladding and foundations.  
*Image by Author.*
- Figure 5.29 – Screw-Jack foundation system sketch.  
*Image by Author.*
- Figure 5.30 – Diagram showing bracing rods when foundations are lowered.  
*Image by Author.*



- Figure 5.31 – Diagram showing bracing rods when foundations are lifted.  
*Image by Author.*
- Figure 5.32 – Diagram showing floorplan of structure with centre of mass and rotation.  
*Image by Author.*
- Figure 5.33 – South elevation with high foundations.  
*Image by Author.*
- Figure 5.34 – East elevation with mixed height foundations.  
*Image by Author.*
- Figure 5.35 – 3D view showing mixed foundations on an uneven surface.  
*Image by Author.*
- Figure 5.36 – South elevation with high foundations.  
*Image by Author.*
- Figure 5.37 – East elevation with mixed height foundations.  
*Image by Author.*
- Figure 5.38 – 3D view showing high foundations on a flat surface.  
*Image by Author.*
- Figure 5.39 – Diagrams showing services.  
*Image by Author.*
- Figure 5.40 – Diagrams showing ventilation.  
*Image by Author.*
- Figure 5.41 – Sketch showing different panel options.  
*Image by Author.*
- Figure 5.42 – Framed panel and panel with screen.  
*Image by Author.*
- Figure 5.43 – Render of combined option.  
*Image by Author.*
- Figure 5.44 – Perspective of combined option.  
*Image by Author.*
- Figure 5.45 – Ground floor of combined option.  
*Image by Author.*
- Figure 5.46 – South elevation of combined option.  
*Image by Author.*
- Figure 5.47 – Perspective at 1:100 scale.  
*Image by Author.*
- Figure 5.48 – South elevation at 1:200 scale.  
*Image by Author.*
- Figure 5.49 – Floorplans at 1:200 scale.  
*Image by Author.*
- Figure 5.50 – East elevation at 1:200 scale.  
*Image by Author.*
- Figure 5.51 – Community elevation.  
*Image by Author.*
- Figure 5.52 – Community render.  
*Image by Author.*

## 6. CHAPTER SIX

- Figure 6.01 – Extreme site sketch.  
*Image by Author.*
- Figure 6.02 – Disaster zone site sketch.  
*Image by Author.*
- Figure 6.03 – Helicopter transportation of building elements.  
*Image by Author.*

- Figure 6.04 – Suburban site sketch.  
*Image by Author.*
- Figure 6.05 – Urban site sketch.  
*Image by Author.*
- Figure 6.06 – AdAPTA-Home components.  
*Image by Author.*
- Figure 6.07 – Image of components fitting into a container.  
*Image by Author.*
- Figure 6.08 – Shipping worldwide.  
*Image by Author.*
- Figure 6.09 – Disaster zone application.  
*Image by Author.*
- Figure 6.10 – Render of post disaster application.  
*Image by Author.*

## 7. CHAPTER SEVEN

- Figure 7.01 – Diagrams of key characteristics in the final design.  
*Image by Author.*
- Figure 7.02 – Render of final scheme.  
*Image by Author.*
- Figure 7.03 – Photograph of final physical model.  
*Image by Author.*